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Our Proselytizing Neighbor

IT MAY be that only a master musician can appreciate the genius of Beethoven, but a mere novice in the power business can detect dissonance in the hum of American industries. For want of fuel from which to manufacture electricity factories in the great industrial state of New Jersey, for instance, are compelled to shut down completely every other day. Industries in other states have been confronted with a like predicament. Such a condition in the power market is not healthy for American industries, and our neighbor to the north is quick to take advantage of it. One of the banks in the prairie provinces, in an advertisement in one of the large metropolitan dailies, called attention last week to Canada's water-power resources, which are at present only about one-tenth developed. As indicative of the possibilities for future industrial expansion, it pointed out that there is 7,000,000 hp. still commercially available in the Dominion and offered to furnish information regarding sites, labor conditions, transportation facilities, etc., to American firms seeking to establish branches or factories there. It is well known that many industries which could not obtain sufficient electricity at Niagara Falls found the authorities on the other side of the border willing to oblige them with power. Others are likely to succumb to the propaganda unless Congress acts quickly on measures now before it. Dr. Steinmetz has a viewpoint on Niagara which we publish this week.

The Curtailment of Lighting

PRESTON S. MILLAR'S paper before the Illuminating Engineering Society last week on this important topic is one of the most valuable contributions to war economics that have yet appeared. The central-station men of the country knew well enough that the resounding calls for saving coal by economizing on electric light had no substantial basis in economic efficiency, but were gags for the gallery, drawing attention to trivial although easily observable savings while the great drains on our coal supply went unchecked. Mr. Millar's study of the facts not only fully upholds these impressions, but leaves the man on the street no excuse for misunderstanding the real truth of the situation. Baldly the facts are these: Of the total coal consumption of the country a beggarly 2 per cent goes to the production of electric light and 1 per cent more would more than cover the additional quantity required for gas lighting. Therefore even the entire abolition of artificial lighting would save less than 3 per cent of the fuel output. The first point of attack chosen in making a reduction of lighting was the electric sign. Now, granted that the electric sign represents in considerable measure an unnecessarily flamboyant phase of an art in many respects offensive to taste, and which could be curtailed without serious public inconvenience, even if electric signs were wholly abolished the total amount of energy that would thus be saved is not in excess of 5 per cent of the energy used for lighting—that is, one-tenth of 1 per cent of the country's fuel output.

Granting that slight reductions may be made in certain other classes of lighting without serious inconvenience, all these curtailments together would amount to only a few tenths of 1 per cent, far less than if the customary room temperature of buildings were cut down two degrees, enormously less than could be saved by the most casual attention to the wastes of fuel in its ordinary domestic use. Even daylight saving, if carried out at once and on the most liberal scale proposed, would not reduce the total coal required for electric lighting by an amount of the slightest importance in comparison with other and familiar wastes. The truth is that nowhere is coal used more efficiently than under the boilers of a well-conducted central station, nowhere is the energy of coal made available with less difficulty and cost than in the electric distribution proceeding from such stations, and, the trouble with our fuel supply being far more in transportation than in lack of raw material, electric transmission and distribution should be encouraged in every possible way in order to relieve the railroads for the transportation of necessary things which cannot be sent over a wire as big as one's little finger.

Lest it be for a moment thought that the central stations are putting in a plea for the preservation of their own particular business, it should be added that they have cheerfully taken their share of the medicine, although knowing full well that it was everywhere being administered ineffectively. Further, experience has already shown in the months since the beginning of hostilities that the enormous industrial demands for power and for lighting necessary work at night are actually going on to increase the business of the central stations beyond their peace-time requirements, and to an extent in which the savings called for by lighting curtailment of all sorts kindly suggested by the Fuel Administration disappear as a drop in the bucket. Beyond this the central-station industry is a regulated one in which all attempts at profiteering can be checked by legal mechanism now existing and in first-class fighting trim. Can this be said of any other industry necessary to the

public welfare? The attempt at price regulation in foods has merely increased as a whole the cost of living, since turning consumption from controlled to uncontrolled channels is merely a new and compelling temptation to the profiteer, as the results have shown. The necessities of war will take care of the business of the central stations without serious effort on their part. Indeed, their chief difficulty will be in meeting the demands for service and in getting the fuel necessary for that part of their output concerning the importance of which there can be not the slightest question.

If it is necessary to save 50,000,000 tons of fuel per year, the place to save it is in the checking of indiscriminate waste in the ordinary utilization of fuel, waste which is at a minimum in electric light stations, and by curtailing with grim determination the use of fuel in industries the continuance of which is not absolutely necessary to the successful prosecution of the war. That these are somewhat difficult to pick out, in face of the opposition of the loud crying interests involved, is perfectly true; but this does not excuse the Fuel Administration for not using every possible effort to this end. If it is thought necessary in addition to squeeze out what little saving may be made in electric lighting, good and well, let the authorities go to it, and they may be assured that the central stations will not seriously suffer thereby and will not raise a storm of protest. On the contrary, the central-station industry will go the limit in backing the country, on the safety and prosperity of which its own future depends.

Power for a Textile District

THE rapidly increasing dependence of the textile industry on electric power is strongly emphasized by the large developments recently undertaken in the New Bedford territory which are described in the current issue. The demands of war orders and the need of cheap and reliable power co-operated in an unprecedented demand on the capacity of the New Bedford Electric Supply Company, with the result that in three years it has jumped from 8000 kw. to 52,000 kw., of which the major portion is already in operation. The result has been not only great increase in local service, but extension into distant territory and intercommunication with other utilities. The new plant here described was started in April, 1916, and was originally laid out for three 4000-kw. units and one of 10,000 kw., all turbo-generators of the ordinary type. In seven months from the beginning of construction commercial power was being delivered from this plant. An additional 15,000-kw. unit has recently been put into operation, and another of the same size is shortly to be delivered.

An interesting feature of the plant is the thoroughness with which the question of coal supply has been considered. Events of the past few months have emphasized this particular matter, but it was undertaken with foresight, and adjoining the station is a storage yard of 20,000 tons of coal. Transportation is by water, and the barges are unloaded at the water front by a hoisting tower with a capacity of 150 tons an hour. This fuel is crushed or by-passed as necessary and then either stored in bunkers or distributed to the yard. At present fuel is withdrawn from the yard by a locomotive crane with a 50-ft. (15.2-m.) beam, but the full provision presently to be installed will include an electric crane of 250-ft. (76.2-m.) span, covering the whole central portion of the yard, with a capacity for 100 tons an hour. The proper organization of coal-storage supply is likely to be for some time a very vital question in station design, and investment in storage facilities is strongly to be recommended. The general description of the plant contains numerous details of interest to the constructing engineer, but the larger phases of the matter and the relation of this great new plant to the surrounding territory are of particular industrial importance.

Measuring Power Loss in Dielectrics of Three-Conductor High-Tension Cables

IN INDUSTRIAL power transmission the importance of high-tension cables increases year by year because population densities increase year by year. In sparsely settled districts and in open country it is advantageous and economical to transmit power over aerial lines. Within city limits, however, it becomes impracticable to transmit power by high tension except over subterranean cables. Consequently, the characteristics and the design of high-tension cables are constantly assuming greater economic importance.

The losses of power in a cable maintained at constant temperature are due to I^2R losses in the conductor and to E^2G losses in the insulator. The linear conductance G includes, however, more than the mere transfer of electrons through the dielectric. It includes also a component due to dielectric hysteresis. Both R and G increase with temperature, although their rates of increase are not the same. Consequently the higher the temperature of the cable the greater the linear loss and the greater the linear production of heat. Each and every cable dielectric has a certain limiting temperature beyond which it is not safe to operate because of rapid ensuing deterioration. The economic problem of operating efficiently any cable once installed consists in working it as nearly continuously as possible up to its safe temperature, but never above this value. The cable temperature at its hottest spot is thus the essential criterion of operation.

In studying experimentally the dielectric power loss in a cable under adjustably varied voltage or temperature it becomes important to measure the power loss, with satisfactory precision, in a test cable sample only a few meters long. In the common case of three-cored cable it is also important to measure this loss by three-phase methods, lest there should be a discrepancy between three-phase and corresponding single-phase dissipation. It is not easy, however, to measure a few watts at a dozen kilovolts three-phase and at a power factor of only a few per cent. Special wattmeter apparatus has to be used and calibrated for such measurements.

In a paper on this subject recently read by F. M. Farmer before the American Institute of Electrical Engineers the preparation and use of a high-sensitivity three-phase reflecting wattmeter is described in connection with such tests. By this means satisfactory wattmeter tests are reported on 3-m. lengths of three-phase cable in the laboratory.

It appears from the paper that the linear watt loss increased somewhat more rapidly than the square of the

voltage, between 5 kv. and 17 kv., and more rapidly than the third power of the cable temperature, between 50 deg. and 120 deg. C. These results are such as might have been expected in regard to voltage, but are very surprising in regard to temperature. When it is considered that doubling the cable temperature within this range may increase the linear power loss more than ten times, the importance of an accurate knowledge of the working temperature of such cables becomes self-evident. We may expect to see recording cable thermometers come into extensive use in central-station operation.

The Selection of Circuit Breakers

THE oil circuit breaker has become a very essential part of electrical equipment, and inasmuch as it is the chief defense against the disastrous results of short circuits its capacity for doing its work is all-important. Therefore the A. I. E. E. paper by Messrs. Hewlitt, Mahoney and Burnham on this topic is one of direct and vital interest to the central station. It is comparatively easy to find out experimentally in the light of experience what a given circuit breaker will stand. The difficulty of the situation lies in estimating the burden which will be suddenly thrust upon it. The capacity of a breaker has been commonly stated in terms of the alternator capacity at a specified reactance, assuming generally normal operating pressure. The actual conditions which may be imposed on the apparatus depend on a far greater number of factors, including several which cannot be readily foretold.

The line of attack upon this difficult problem made by the authors is an approximation, involving only reactance and a somewhat conventionalized time-current decrement ratio. Curves representing the latter are based by the authors on effective current values rather than corresponding peak values and also take into account the increased flux due to the assumed load conditions. The data concerned have been founded on careful experimental study, and a series of examples covering common and typical cases are worked out to show the short-circuit currents for which allowance must be made and therefore the necessary capacity of the circuit breaker. The method seems to lead to an approximate solution of direct value to the engineer and to represent a material advance in a particularly difficult line of investigation. With the great increase in the capacity of generating stations and in the extent of the distribution networks, results of a breakdown are so serious that investigation of the circuit breaker problem cannot be too thorough, and the one before us appears to represent a long step in the right direction, since it puts the working data for ordinary cases upon a sound experimental basis.

Effects of Frequency and of Wave Form on Vapor Rectifiers

THE mercury-arc rectifier for obtaining direct currents from a single-phase alternating-current circuit is a valuable piece of apparatus and is especially useful for charging storage batteries when direct-current mains are not available. The great advantage of such a rectifier is that it employs no rotating machinery. If any motion of parts can be said to exist in the rectifier, it is the rectilinear motion of electrons within the evacuated chamber.

The behavior of a mercury-arc vacuum tube in a simple direct-current circuit may be outlined fairly well for most practical purposes by saying that the tube introduces a nearly steady drop of potential or counter emf.; so that the power lost in the tube is likewise steady and the output bears a simple relation to the power input when the current and voltage at either end are known. When, however, an alternating-current circuit is the source of power the behavior of a rectifier is not so simple. Two rival theories have developed for arriving at an expression of the tube losses. The first theory minifies the influences of frequency and of wave form at the alternating-current input terminals and concentrates attention on the apparent voltage drop taking place in the tube. This apparent voltage drop is held to remain roughly constant over the range of working currents employed, so that the tube loss and tube efficiency can be readily computed to a first and ordinarily sufficient degree of approximation when the terminal conditions are known. The second theory magnifies the influences of frequency and of wave form and holds that any proper estimate of the tube losses must take both of these considerations into account.

It is doubtful whether there is any serious discontinuity between the two theories above mentioned. The first theory does not seriously deny the possible influences of frequency or of wave form. It merely seeks to overlook these, as of relatively minor importance, for ordinary practical purposes. If, indeed, the losses in a mercury-arc rectifier were entirely independent of frequency or wave form, the device would in these respects be entirely different from any employed in connection with alternating-current circuits. There is always some effect of frequency and some effect of wave form. The only question from an engineering point of view is as to the amount of such influence.

The article by Dr. William Tschudy which we print this week goes to show that the tube loss is very appreciably increased by irregularities in wave form, as well as by increase in frequency, between the limits at least of 40 and 110 cycles per second. We hope that the question will be discussed further in our columns. There is undoubtedly room for more investigation in this matter.

The Coming Issues

IN THE next issue of the ELECTRICAL WORLD a representative of a Middle West electric service company will tell how he avoided a considerable loss when it became necessary to change the frequency of the system. He will outline in a very convenient way the modifications which were made in all different types of meters to adapt them to the change. Prof. C. E. Clewell will again contribute to this issue, his subject being the use of graphic meters in motor application work. Among other subjects which will be discussed will be the initial current and voltage rush in incandescent lamps of the vacuum and gas-filled types when first connected with the supply circuit.

New 52,000-Kw. Station of New Bedford Company

Engineering Features of Largest Steam-Turbine Plant in South Massachusetts, Which Supplies Important Textile District with Power and Is Interconnected with Other Utilities in Buzzards Bay and Cape Cod Region

THE increased production demanded of Massachusetts textile plants by war orders and a growing appreciation of the value of central-station power have resulted in the expansion of the generating facilities of the New Bedford Gas & Edison Light Company from a rating of 8000 kw. in 1915 to a designed capacity of 52,000 kw. in 1917, 37,000 kw. of which is now installed in a new station on Cannon Street, New Bedford, the largest turbine plant in southern Massachusetts. The output of the company shows an increase for the first six months of 1917 of 86.7 per cent to 207.1 per cent above the corresponding months of 1916. Among the factors that have led to the sudden general realization of the value of central-station service are the present high cost of fuel and the shortage of capital for industrial plant development. From a company giving purely local service on a small scale this organization has lately developed to a point where its service extends into distant territory. Through interconnection with other utilities maximum efficiency of electrical supply is afforded over a wide area of utilization.

The Cannon Street station was laid out for three 4000-kw. units and one 10,000-kw. set. A 15,000-kw. unit was authorized in the summer of 1916 and is now being operated in the station; a second 15,000-kw. unit will be delivered shortly, the building having been extended last fall to house the machine and its auxiliaries. The old Coffin Street station is being dismantled and the equipment disposed of with the exception of four boilers, two 4000-kw. turbo-generators and auxiliaries, which have been scheduled for service in the new plant.

The Cannon Street station is situated on the shore of Buzzards Bay, which assures an ample supply of condensing water and coal delivery by barges. The plant is near the company's load center, within about one-half mile (0.8 km.) of the business section and practically half way between the groups of textile mills at the north and the south ends of the peninsula on which the city stands. A side track of the New York, New Haven & Hartford Railroad enters the turbine room. The plant is well outside the residential district, away from the fire risk associated with that part of the city. Adjoining the station is a yard with a storage capacity of 20,000 tons of coal, at present equipped with an automatic railway, locomotive crane, tracks, hoisting tower and other facilities for fuel supply on a large scale.

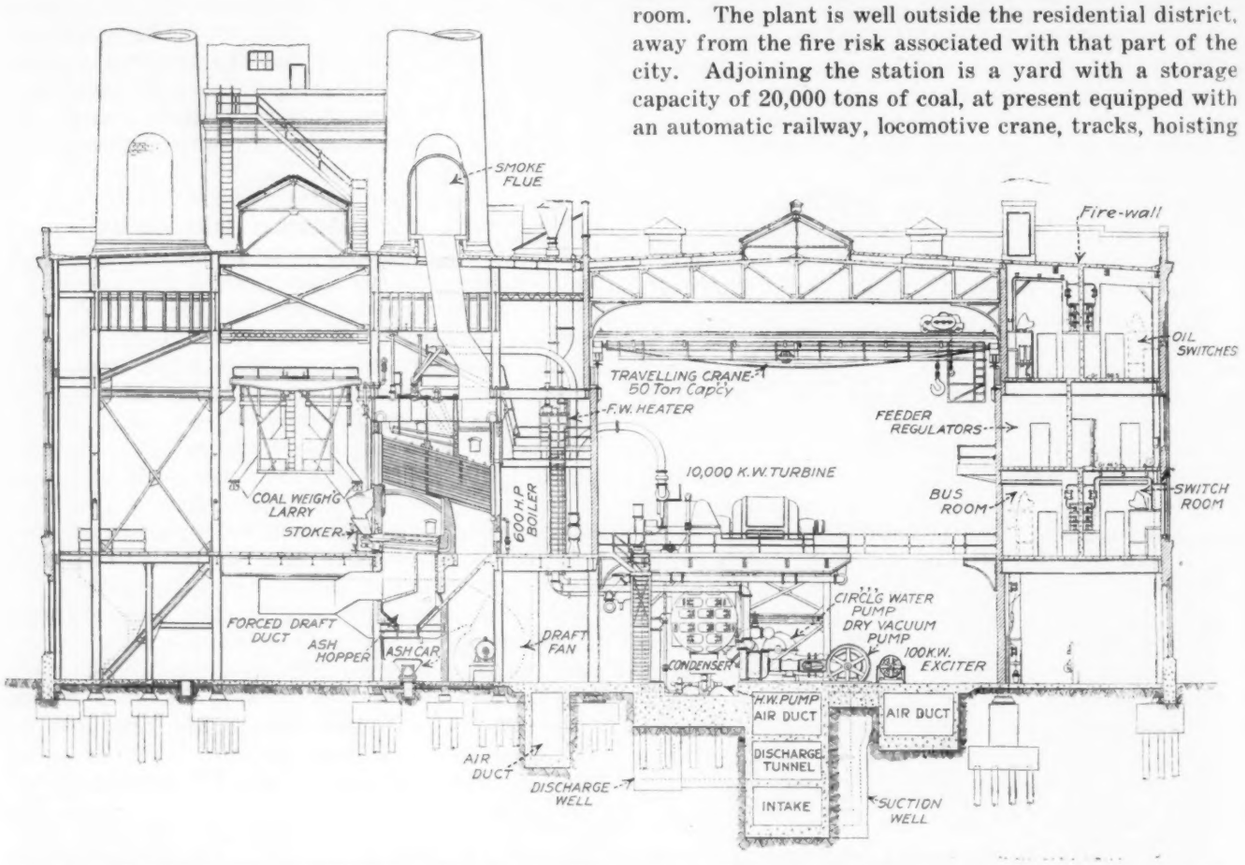


FIG. 1—ARRANGEMENTS FOR DISTRIBUTING COAL TO BOILERS; SMOKE BREECHINGS ON ROOF ARE AMONG FEATURES SHOWN

Coal is now temporarily stored in a 1000-ton bunker situated at the east end of the boiler room on the center line of the firing aisle, but sufficiently above it to enable coal to be handled from the bunker to the boilers by an electrically operated traveling larry run-

ning from end to end of the building. A basement 20 ft. (6 m.) high extends under all sections of the station.

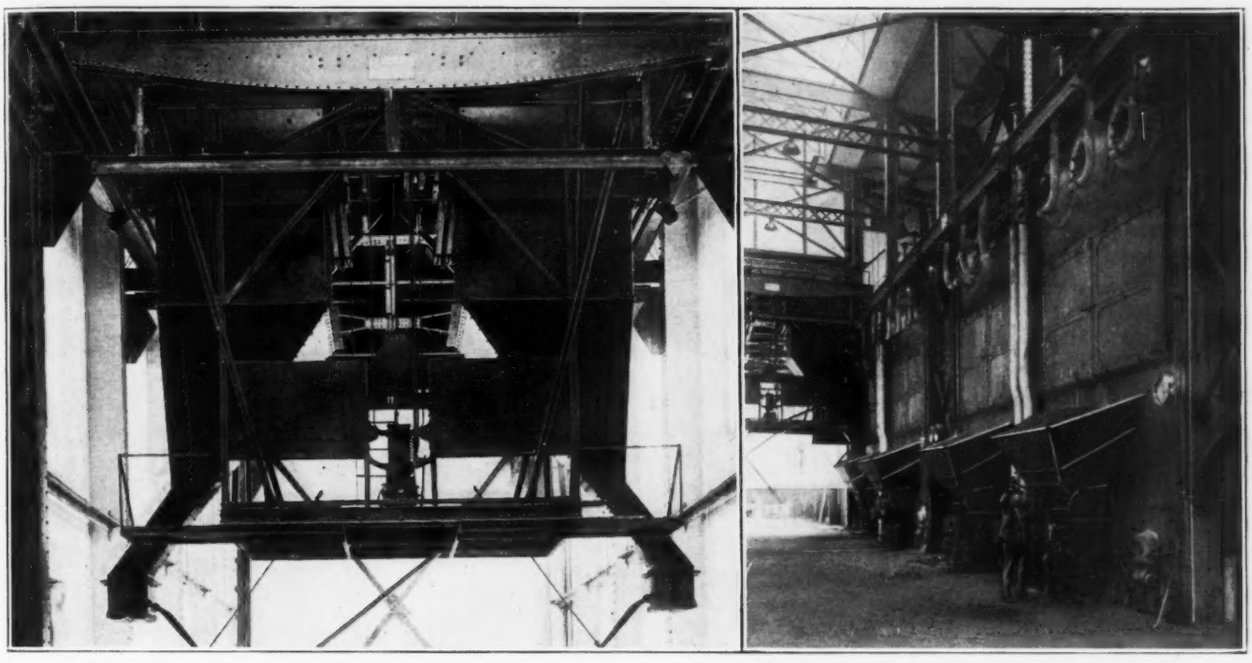
ELABORATE COAL-HANDLING FACILITIES

Coal is brought to the station in barges and unloaded at the waterfront by a hoisting tower built by the Maine Electric Company, Portland, Me., its capacity being 150 tons per hour. The tower is equipped with a 50-ft. (15-m.) boom, the main hoist being provided with a 1⅝-cu. yd. (1.26-cu. m.) Haywood clamshell bucket and driven by a 225-hp. General Electric 550-volt induction motor. The trolley on this hoist is driven by a 50-hp. motor. The tower is equipped with a Robbins two-roll coal crusher driven by a 30-hp. motor. The coal is fed to the crusher or by-passed immediately after being hoisted from the barge and is then delivered by gravity into a 3.5-ton receiving hopper, from which it is discharged into an automatic industrial railway car and distributed around the storage yard by gravity dumping and automatic tripping or else fed into an elevated receiving hopper near the north wall of the station. The industrial railway has a capacity of 120 tons per hour. From the receiving hopper outside the plant a swiveling belt conveyor driven by a 7.5-hp., 550-volt motor delivers the coal into either of two track hoppers set in the ground just outside the coal bunker section of the power house. Two 1-ton Hunt skip hoists driven by two 30-hp. motors elevate the coal to the bunker, the hoists being operated by Cutler-Hammer push-button control and solenoid-type switches.

Coal is reclaimed from the yard by a 15-ton steam-driven Link-Belt locomotive crane with 50-ft. (15-m.) boom and 1.5-cu. yd. (1.12-cu. m.) bucket, running on a standard-gage track serving the various parts of the yard and carried over the track hoppers adjoining the bunker house. From the storage yard coal is loaded into a 20-ton hopper-bottom gondola car by the locomotive crane for delivery to the track hoppers, the crane being used to drill the car about the yard. The company has recently purchased a second crane of the locomotive type for yard service. This unit is a McMyler 20-ton outfit and, with the first crane, will be used in trimming and reclaiming the coal and also in handling ashes outside the station.

This coal-handling installation is to be improved later by the removal of the automatic industrial railway and the provision of an electric crane of 250-ft. (76.2-m.) span which will cover the central portion of the yard and enable fuel to be handled directly from the storage piles to the track hoppers and reclaimed with maximum convenience. The crane will have a capacity for handling about 100 tons per hour and will be equipped with a bucket of about 2 cu. yd. (1.52 cu. m.) capacity. The present locomotive crane can transfer about 60 tons per hour into the skip-hoist pit. A second unloading tower will also be required in the future, when both towers will be equipped for service on a track system to be constructed on the waterfront, following the completion of bulkhead improvements now under way.

Coal is discharged from the bunker at the end of the



FIGS. 2 AND 3—DOUBLE-ENDED COAL-WEIGHING AND DISTRIBUTING LORRY AND ONE SIDE OF BOILER-ROOM AISLE

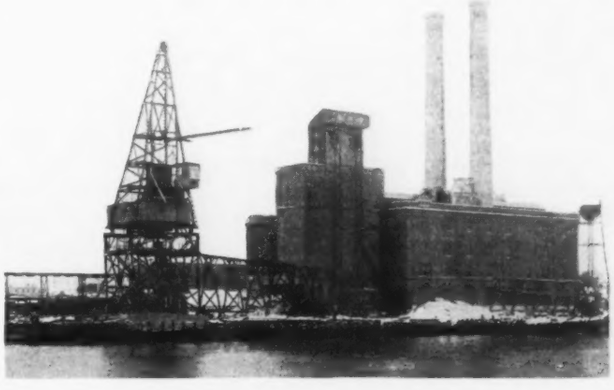


FIG. 4—OUTDOOR COAL-HANDLING FACILITIES

boiler house into a Mead-Morrison larry with two 12-ton hoppers which are equipped with Fairbanks ticket-registering scales. The larry is operated along the firing aisle at a maximum speed of 100 ft. per minute by a 7.5-hp., 550-volt General Electric induction motor, and discharges into the stoker hoppers on either side of the boiler room. The convenience of this arrangement is illustrated by the fact that when the boilers were first placed in service and before the full staff of the station was transferred from the Coffin Street station one man operated the larry, cleaned the fires and supplied four boilers with 60 tons of coal in eight hours, also looking after the service of the four units.

FEATURES OF BOILER AND FURNACE EQUIPMENT

The boiler room is designed to accommodate sixteen 600-hp. boilers set in eight batteries, four on each side of a firing aisle 16 ft. (4.8 m.) wide. Ten Babcock & Wilcox boilers are now in place, each being designed for operation at 200 lb. (14.2 kg.) steam pressure and 125 deg. Fahr. (51.7 deg. C.) superheat. Four of the sixteen boilers will be equipped with Babcock & Wilcox superheaters and the remainder with Foster superheaters. The boilers are designed for operation at 300 per cent of their rating, their maximum efficiency being attained at 160 per cent of rating. The boilers equipped with B. & W. superheaters came from the Coffin Street station. All the boilers are equipped with the Combustion Engineering Company's type E underfeed stokers.

An unusual feature of this installation, suggested by R. H. Barber, chief engineer of the station, is an arrangement whereby the dust chamber of the rear pass at the back of the bridge wall can be cleaned by opening a damper discharging into the ash hopper, as shown in the station cross-section reproduced herewith. A windlass is provided in the basement below each damper for operating the latter by hand. The arrangement, in the opinion of the operators, is far superior to the usual method of cleaning out the dust chamber by shoveling or vacuum system. With the New Bedford arrangement a boiler dust chamber can be cleaned when the boiler is in service, the fire room is relieved of the dirt and dust usually associated with cleaning, and the staff is saved a vast amount of personal discomfort.

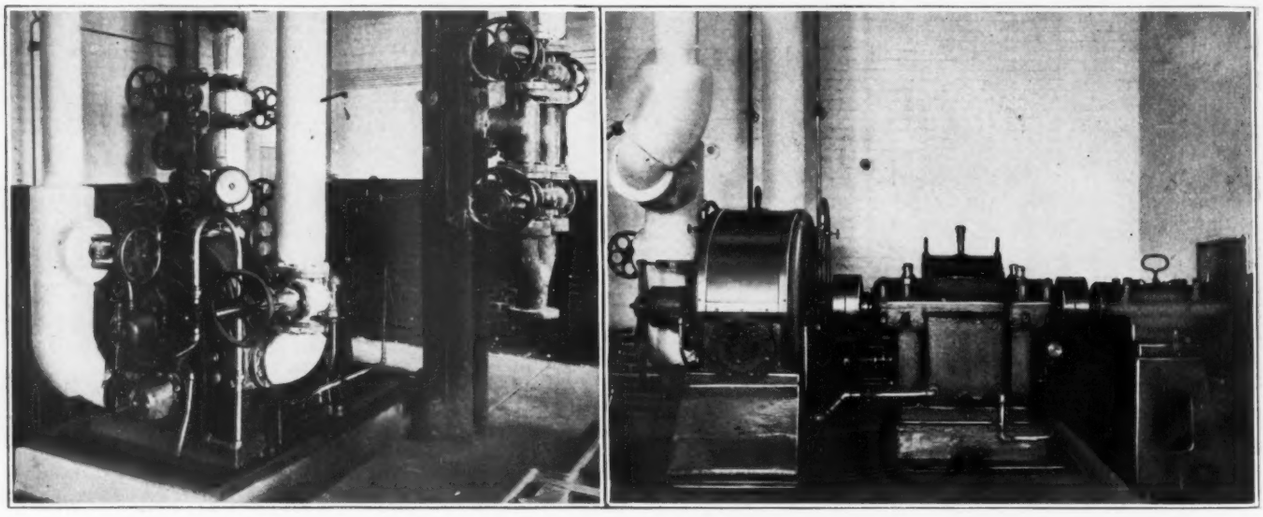
Ashes are dumped from the furnace ash pits into a hopper-bottomed car running on a narrow-gage track leading to a 30-ton ash pit outdoor. This service will shortly be provided by an Elwell-Parker 2-ton industrial electric truck.

Another useful feature is the provision of 18-in. (25.72-cm.) nipples in place of the usual 9-in. (12.86-cm.) connections between the header and the steam drum. This gives much more room than is ordinarily the case for inspection and repair work around superheater and drum and makes it possible to rivet or calk a drum without removing the superheater.

The hopper above each stoker is designed to hold about 2.5 tons of coal. A slot-shape opening has been left between the upper and lower parts of the hopper which enables the fireman to see when the coal is low.

The air supply for the furnaces is taken from the basement and forced into a duct system under the firing-aisle floor which feeds the stoker wind boxes. Four Green fans driven through Falk reduction gears by Terry steam turbines provide the forced draft.

The products of combustion are discharged from the boiler uptakes into inclined breechings leading through the boiler-house roof to horizontal smoke ducts running along the roof and joining two reinforced-concrete stacks. The first 75 ft. of the stacks (22.86 m.) is brick-lined to resist the action of the gases. By placing the stacks midway between each end of the firing aisle and discharging smoke into them from each side the steam generating equipment does not have to be separated for stack foundations, the symmetry of station is improved, the size of building for a given boiler capacity is minimized, and some of the boilers can be placed directly under the stacks. The stacks were built by the New York Concrete Construction Company and are equipped with lightning rods. The flue-gas temperatures in this station ordinarily range between 550 deg. and 575 deg. Fahr. (about 293 deg. C.), or about 15 deg. below the steam temperature, including superheat at the boiler uptake. The stoker fan engines are controlled by the steam pressure and the stoker engines by the air pressure in the wind boxes, the system being the so-called balanced-draft type, furnished by the Engineer Company, New York.



FIGS. 5 AND 6—SOME OF THE AUXILIARY DRIVES

This article will be continued in a subsequent issue of the ELECTRICAL WORLD.

Mobilizing Niagara to Aid Civilization

All Its Power Is Urgently Needed by the State and Nation, and Tourists Could View the Mighty Cataract on Sundays and Holidays

BY CHARLES P. STEINMETZ

THE unprecedented and acute shortage of power which now confronts us and threatens seriously to interfere with the efficient prosecution of the war again turns our eyes to Niagara, where water capable of producing millions of kilowatts rushes uselessly over the cliffs.

At the same time we must realize that the present situation is not unexpected, nor was it unavoidable. The emergencies of war times have merely made a sudden and acute condition of a situation which has been coming on for a long time and would sooner or later have overtaken us. We thus turn again to a fuller use of Niagara's power, too late indeed to get the fullest benefit of it in our present emergency.

In the discussion of the development of Niagara's power versus the preservation of the natural beauty of the falls two features have to be recognized:

(1) The falls are doomed in any case, and sooner or later, with the increasing power demand of modern civilization and increasing shortness of power, self-preservation will force us to use Niagara's power to the fullest extent; that is, let the falls run dry.

(2) It is too late to preserve the natural beauty of the falls. That could have been done a hundred years ago, but not now, when there is no place at or around the cataract where one's sense for nature's wild beauty is not offended by the sight of some ugly modern hotel, some tower or steel bridge.

About fifteen years ago I proposed a plan which, while using the full power of the falls, would preserve their beauty to the sightseer. At that time the suggestion was not taken seriously—the demand for the power was not then so urgent as to-day—and therefore I repeat it now.

Suppose we permit the complete development of Niagara's 10,000,000 kw., more or less, for electrical purposes, let the falls run dry, but on every holiday and Sunday have the power houses shut down, the power consumption reduced to the minimum possible—say 10 per cent of the full capacity—and so have the falls running again in their ancient grandeur. We could thus satisfy the demands of modern industry and at the same time satisfy the lovers of nature; and, more than that, we would then see a sight which can be seen nowhere in the world—the starting of the falls, when on Sunday morning the water would first begin to trickle over the bare cliffs and then gradually rise to be the giant falls of old.

As the government controls the falls, it would involve no serious difficulty, probably not even require legislation, to give the license for the unlimited use of power with the condition that during Sundays and holidays the power consumption must be reduced to 10 per cent of the maximum.

In considering the full development of Niagara's power we must remember that some hydraulic engineering work will be required to insure uniformity of the flow of water, for Niagara fluctuates in its quantity with the shifting of the winds on Lake Erie. However, the cost of such a development per kilowatt would be insignificant. It probably would mean a movable dam across the Niagara River at Buffalo to restrict the flow when the lake was high and open it wide when the lake was low.

Applications of Flywheels in Motor Operation

Theoretical and Practical Consideration of the Effect Which They Exert—Good Results Are Achieved Where Load Equalization Is an Object—Excess Inertia Disadvantageous with Some Machines

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

Theoretical notes on the use of flywheels for the equalization of loads, with a reference to cases where flywheel effect may be a disadvantage. Outline of applications of flywheels to motors, with descriptive notes on the Ilgner system as an example. Value of flywheel effect in the operation of hoisting-machinery reversing rolls in steel mills and for improving service conditions.

FLYWHEEL effect is sometimes favorable and other times unfavorable to the operation of motors and motor-driven machinery. The former is true where flywheels are used for load equalization, some cases being referred to in the following notes. The disadvantages of flywheel effect become evident in connection with some machine tools like the planer, where an excess inertia in pulleys and in the motor armature increases the difficulty of reversing the movement of the platen.

Some idea of the dimensions which may occur with pulleys on planer equipments may be gained from Fig. 3, which refers to a non-reversing motor-driven equipment. To reduce the flywheel effect aluminum has been used to some extent for planer pulleys. Reduction of the diameter of the motor armature may also make a considerable reduction in the flywheel effect. Calculations indicate that changing the diameter of a 19-in. (39.26-cm.) armature only 5 in. (12.7 cm.) changes the flywheel effect about 100 per cent (Popcke). The same authority points out the rather remarkable fact that a 7½-ton planer platen when moving at a speed of 100 ft. (30.5 m.) per minute has only about one-twenty-fifth of the inertia of a 35-hp. motor when operating at a speed of 1000 r.p.m. These figures give some idea of the possible magnitude of the flywheel effect from the rotational elements of motor-driven machinery and indicate the extent of their disadvantage in reversing applications.

It should be clearly noted that the objection to flywheel effect in reversing service as just outlined refers merely to the difficulty in accomplishing the reversal. Another and important characteristic of reversing service is the excess momentary demand made on the motor-supply circuits at the time of reversal. During this period the flywheel effect can be made to perform a useful function, as will be described later.

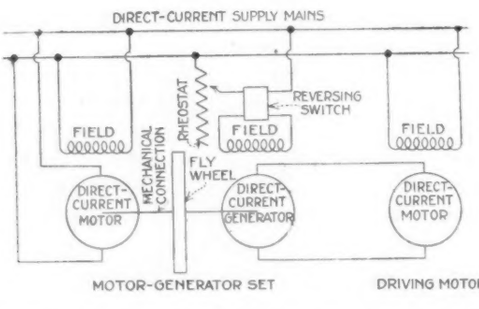
Of the two general methods for preventing disturbances due to excessive load fluctuations—by storage battery and by flywheel—the former is applicable to carrying peak loads in central stations, but the latter is not suited to such conditions, since the peak loads exist too long. The flywheel is strictly a "momentary load" absorber or carrier. This is well illustrated by the fact that a given flywheel may be able to handle, say, a 100 per cent overload for a period of one second, while the same flywheel might be entirely incapable of handling even 50 per cent overload for, say, five seconds.[1]

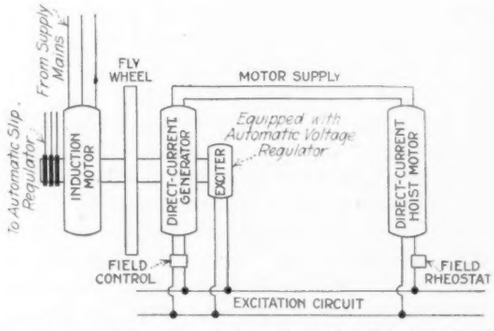
The so-called "flywheel effect" is the product of the weight of the flywheel and the square of the radius of gyration, while the amount of energy which such a wheel can give up depends on the difference of the squares of the initial and final speeds. A good idea of the flywheel action upon a motor in which the load torque suddenly changes from a lower to a higher value may be gained from the following equation:

$$T = T_1 - (T_1 - T_o)/\varepsilon^{at},$$

where T_o represents the initial constant opposing or load torque and T_1 a new constant and higher value of the opposing or load torque, the change from T_o to T_1 taking place suddenly. In this equation T represents the torque developed by the motor t seconds after the opposing torque was T_o. The constant a is defined by the following relation: $a = 308R/K^2WN$. R is the ratio of the torque in pound-feet to the slip (an induction motor is assumed) for the given motor, obtained from the motor characteristic curves; K is the radius of gyration of the flywheel in feet (ignoring the inertia of the other rotating parts, which are usually negligible when compared with that of the flywheel); W is the weight of the flywheel in pounds and N the synchronous speed of the motor in r.p.m.

In the original equation ε is the base of the natural logarithm, and hence the torque T developed by the





FIGS. 1 AND 2—SIMPLIFIED DIAGRAMS OF ILGNER SYSTEM FOR DIRECT-CURRENT AND ALTERNATING-CURRENT SUPPLY

[1] "American Handbook for Electrical Engineers," p. 547; section by D. B. Rushmore and E. A. Lof. The discussion of the following equation is based on this section.

motor does not change instantly when the load torque increases from T_0 to T_1, but it increases slowly, depending on the factor a. An inspection of the elements which constitute this factor shows that a may be made small (the condition for a slow increase in the motor torque T for a sudden increase in load) by the use of a flywheel possessing a large flywheel effect, by using a

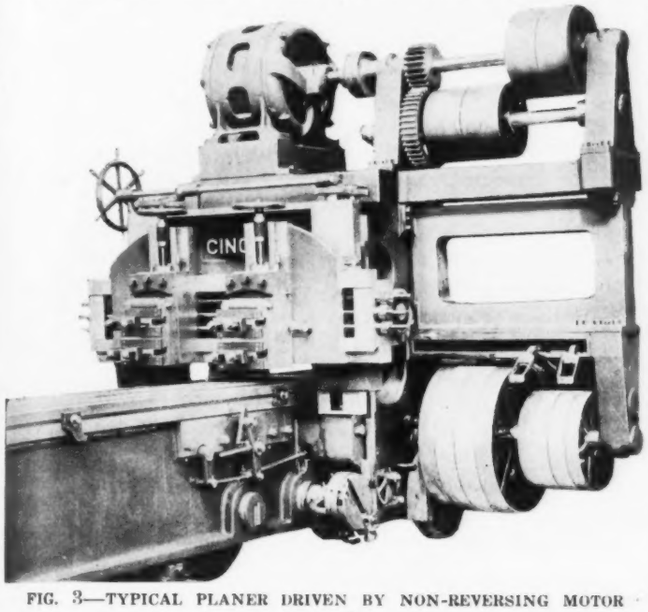


FIG. 3—TYPICAL PLANER DRIVEN BY NON-REVERSING MOTOR

high-speed motor, or by using a motor with large slip for a given torque. Hence if the flywheel effect is made large enough the motor torque may change only slightly when the load increases momentarily, and the load requirements may be back to normal conditions again before the motor torque has had time to change to any extent.

PRACTICAL CASES

To illustrate these theoretical points several practical examples will be given. In the operation of reversing rolling mills in steel plants direct-current motors are commonly employed for driving the rolls. To prevent excessive fluctuations in the supply circuits during the

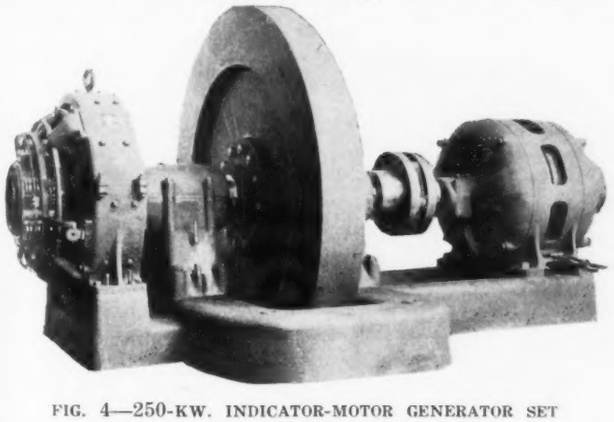


FIG. 4—250-KW. INDICATOR-MOTOR GENERATOR SET

reversing periods the Ilgner system, consisting of a flywheel motor-generator set, is commonly employed. The motor of this set may be either direct-current or alternating-current, although in large outfits the motor of the set is of the polyphase induction type, with arrangements for automatic changes in the rotor resistance so as to increase the slip for excessive loads.

The generator of the set is of the direct-current type with a field reversing switch and a rheostat, permitting wide adjustment of the excitation. The armature of the direct-current generator and that of the driving motor are connected directly to each other, as in Figs. 1 and 2.[2] Changes in speed of the driving motor are thus effected by changing the direct-current generator voltage through adjustments of its field rheostat, and reversal by changing the polarity of the direct-current generator.

The function of the flywheel in such cases is to minimize fluctuations in the supply circuits which furnish current to the motor of the motor-generator set. For successful operation there must be a sufficient drop in speed of the left motor in Figs. 1 and 2 to enable the flywheel to give up the required amount of its stored energy according to the equation[3] $W(V_1^2 - V_2^2)/(2g \times 550)$ = energy available from the flywheel in hp.-seconds. W is the weight of the flywheel in pounds, V_1 is the maximum velocity of the flywheel at its radius of gyration in feet per second, V_2 the minimum velocity at its radius of gyration in feet per second, and g the acceleration due to gravity (32.2 ft. per second per second). This equation implies that some arrangement must be provided for the control of the motor of the motor-generator set.

SAFE SPEEDS FOR CAST-IRON FLYWHEELS WITH SOLID RIMS
(SEE FOOTNOTE 8)

Diameter of Flywheel (Ft.)	Maximum Safe Speed (R.p.m.)	Diameter of Flywheel (Ft.)	Maximum Safe Speed (R.p.m.)	Diameter of Flywheel (Ft.)	Maximum Safe Speed (R.p.m.)	Diameter of Flywheel (Ft.)	Maximum Safe Speed (R.p.m.)
1	1680	8	210	15½	108	23	73
1¼	1344	8½	198	16	105	23½	72
1½	1120	9	187	16½	102	24	70
2	840	9½	177	17	99	24½	68
2½	672	10	168	17½	96	25	67
3	560	10½	160	18	93	25½	66
3½	480	11	153	18½	91	26	65
4	420	11½	146	19	89	26½	63
4½	373	12	140	19½	86	27	62
5	336	12½	134	20	84	27½	61
5½	305	13	129	20½	82	28	60
6	280	13½	124	21	80	28½	59
6½	258	14	120	21½	78	29	58
7	240	14½	116	22	76	29½	57
7½	224	15	112	22½	74	30	56

While the flywheel motor-generator set is the equipment most widely used for load equalization, other types are commercially available, such as the flywheel motor balancer and the use of the auxiliary induction motor drive for large hoists with flywheel equalization. Taking up the flywheel motor generator equipment, the practice of one manufacturer[4] is to use a wound rotor induction motor for driving the set. An adjustable rheostat is connected to the collector rings of this motor (Fig. 2) and its control governed by the input to the induction motor. One type (a usual form) of this rheostat is known as the "liquid slip regulator," which is controlled by a small auxiliary induction motor, the phases of which are each connected in series with one of the mains which supply the main induction motor.

Utilization of the stored energy in the flywheel is accomplished as follows: If the current supplied to the

[2]Figs. 1 and 2 are simplified diagrams based on standard diagrams for these systems as found, for example, in the "Standard Handbook for Electrical Engineers," pp. 565 and 1215. Figs. 3, 4 and 5 are shown by courtesy of the Crocker-Wheeler Company.
[3]Wilfred Sykes, "Standard Handbook for Electrical Engineers," p. 1250.
[4]General Electric Company. See *Bulletin* No. 48,014, pp. 18 and 19.

main induction motor (Fig. 2) rises above some prescribed value, the torque of the small auxiliary induction motor, whose phases are in series with the main supply leads, increases, and this in turn lifts the electrodes of the liquid slip regulator, thus inserting additional resistance in the rotor circuit of the main induction motor.

This action causes the set, and consequently the flywheel, to slow down; the input to the main induction motor is limited, and the flywheel gives up its stored energy. This helps out the main induction motor and prevents excessive peaks in its load. When the load on the set is reduced the reverse action takes place, since the reduced torque of the auxiliary regulating motor causes a decrease in the rotor adjustable resistance, an increase of the main motor speed, and energy is thus again stored in the flywheel for use at the time of the next peak load on the driving motor (to the right in Figs. 1 and 2).

In rolling-mill practice the speed variation to permit storing and utilizing energy in the flywheel may amount to 15 or 20 per cent. Test curves of a flywheel set of this kind show that the flywheel is capable of limiting the load taken from the supply mains to about one-fourth of the maximum output of the generator of the motor-generator set.

This description of the flywheel set, as commonly used, indicates that the use of the flywheel has an influence on the design of the motor to which it is applied. It has been pointed out[5] that the design of the motor and flywheel as a unit ought properly to be a compromise between (a) the advantages sought by the use of a flywheel and (b) those disadvantages which result from the special features required in the design of the motor if the flywheel is to be effective. Summarizing, Mr. Pauly says, in effect, that to increase the range of speed over which the flywheel motor unit is to operate for the purpose of increasing the $(V_1^2 - V_2^2)$ factor in the equation for energy given up by a flywheel may have the following effects: (a) Higher cost of the motor, (b) reduced motor efficiency, (c) extra complications in the control scheme, and (d) a considerable effect, both in quantity and quality, on the work to be performed.

From the standpoint of the flywheel an increase in the factor $(V_1^2 - V_2^2)$ may mean (a) a lower cost for the flywheel and (b) reduced power for its operation. Obviously, therefore, the design of the flywheel and of the motor as a unit involves factors which are opposed to each other and necessitate an engineering balance.

One of the largest and most interesting examples of a flywheel-set installation is that of the motor-driven 35-in. (88.9-cm.) blooming mill at the Lehigh plant of the Bethlehem Steel Company.[6] This flywheel set is capable of handling a 19-in. by 23-in. (39.26-cm. by 39.42-cm.) ingot weighing 10,000 lb. (4535 kg.). Direct motor drive is employed with two 600-volt motors, which develop a maximum torque of 1,550,000 ft.-lb. (214,000 m.-kg.) and a maximum horsepower of 12,000. Two generators are employed. The rated power of the driving motor is 2000 kw. From the flywheel end, two points are of special interest, namely, the weight of the flywheel, 100,000 lb. (45,359 kg.), and its speed of 375 r.p.m.

Considerable attention was given the choice of this speed, which not only affects the operation of the flywheel, but also the design of the generator. It is pointed out that a speed of 500 r.p.m. might have been used for this Bethlehem set as far as the design of the generators was concerned, but that the use of the lower speed (375 r.p.m.) gave a greater margin as an allowance for uncertainties in operating this equipment.

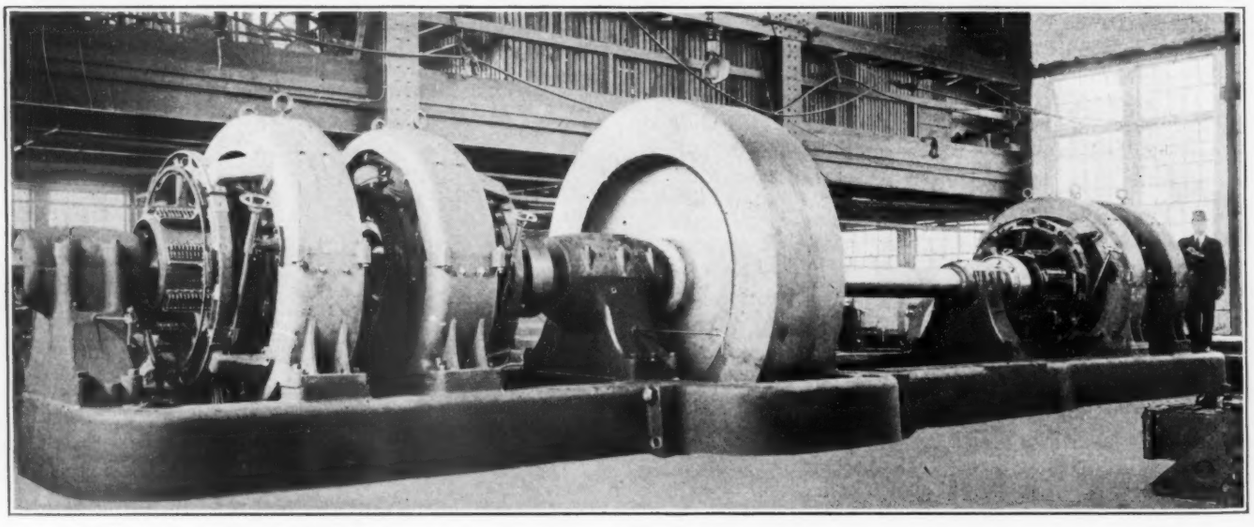


FIG. 5—2000-KW. FIVE-UNIT FLYWHEEL INDUCTION-MOTOR GENERATOR SET (WITHOUT MOTOR)

Cast-iron flywheels are most commonly used in installations comparable with rolling-mill drive, and have a limiting peripheral speed of about 6000 ft. (1828.8 m.) per minute. With special construction peripheral speeds as high as 30,000 ft. (9144 m.) per minute are used.[7] Some idea of the safe maximum speeds in r.p.m. for various diameters of the flywheel may be gained from the table[8] for cast-iron flywheels with solid rims. This table, however, is merely illustrative, since the maximum safe speeds are a function of the kind of flywheel and of the allowable stresses in the wheel.

[5]Discussion by K. A. Pauly, *Transactions A. I. E. E.*, Vol. 34, p. 211.

[6]Discussed by W. Sykes and D. Hall, *Transactions A. I. E. E.*, Vol. 35, p. 501.

[7]"Standard Handbook for Electrical Engineers," fourth edition, p. 1251.

[8]From "Machinery's Encyclopedia," Vol. III, p. 163.

Factors Affecting Vapor-Rectifier Performance

Bulb Losses Greatly Dependent on Wave Form, Frequency and Anode Current—Refutation of Some Other Conclusions That Have Been Erroneously Drawn from Imperfect Investigations

BY DR. WILLIAM TSCHUDY

SOON after the results of the writer's extensive investigations[1] with mercury-vapor rectifiers were published, the Physikalische Reichsanstalt[2] presented some investigations on the same subject which seemed to contradict[3] those made by the writer. Since it is not only

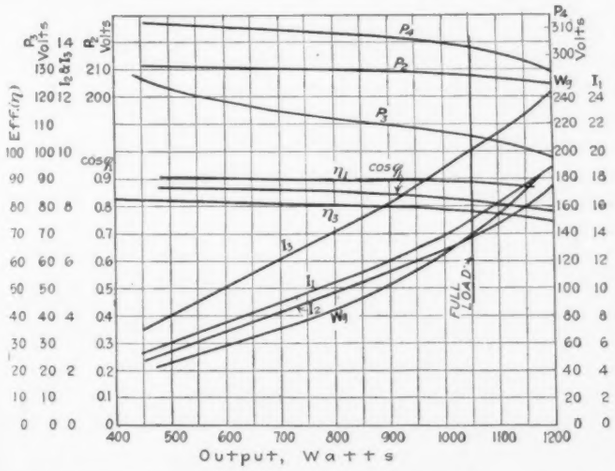


FIG. 1—LOAD CHARACTERISTICS OF A RECTIFIER FOR CONSTANT PRIMARY VOLTAGE AND NORMAL FREQUENCY (SEE TABLE III)

of theoretical interest but of practical importance to have correct ideas on this matter, the writer thinks it worth while to make a detailed comparison of the two investigations in order to demonstrate the correctness of his earlier conclusions.

The Physikalische Reichsanstalt draws the following conclusions: (1) The watts loss in a rectifier bulb can be represented by the voltage drop in the mercury arc; (2) this drop or loss decreases slightly with an increase of the anode current and (3) is independent of the wave form and frequency of the current which is rectified.

To sustain these claims the following reasoning and tests (Tables I and II) were presented: If i represents the instantaneous value of the anode current and e the instantaneous value of the anode voltage, then the watts loss is

$$W_g = \frac{1}{T}\int_0^T idt$$

where T is the length of one period. During the time when the instantaneous current values are greater than zero, the instantaneous voltage values are considered constant[4], therefore

$$W_g = \frac{e}{T}\int_0^T iedt$$

or $W_g = eI_m$, where I_m is the average value of the anode current and e is identical with the voltage drop in the mercury arc and is considered constant.

In connection with Table 1,[5] from which conclusions (1) and (2) were drawn, it was apparently assumed, although not definitely stated, that the primary voltage of the rectifier was constant. In Table II,[6] from which conclusion (3) is drawn, it must be pointed out that the primary voltage of the rectifier and the output are not recorded. Furthermore, no data confirming the conclusion that the bulb loss is independent of the wave form are given.

From investigations[7] made by the writer, however, he is led to believe that the bulb losses are greatly dependent on the wave form, frequency and anode current, and that the Physikalische Reichsanstalt conclusions are incorrect. Assuming that the reader already knows the correct definition[8] of bulb loss, it is evident that it is incorrect to consider the voltage drop in the mercury arc as a loss. Neither is voltage drop e constant for all anode currents, since there is a variation of 18 per cent as shown by Table I. Besides, there is a difference between measured and calculated values of e, so that in total there is a difference of about 20 per cent. Therefore the assumption that the voltage drop e is constant has to be made with precaution.

With the arrangements shown in Fig. 3 the writer obtained the data[9] shown in Table III for an absolutely constant primary voltage of 110 volts and a frequency of 50 cycles when the load was increased step by step. Results[10] were also secured with a constant primary voltage and different frequencies. The transformer bulb and rectifier efficiencies η_{i1}, η_{i2} and η_{i3} respectively are shown in Fig. 5 as functions of the normal frequency (50) and a constant primary voltage (110).

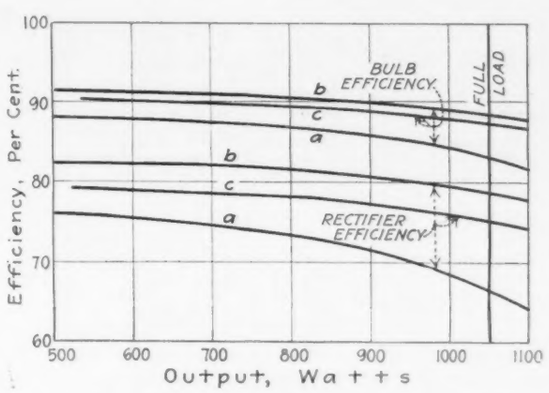


FIG. 2—BULB AND RECTIFIER EFFICIENCIES AT DIFFERENT OUTPUTS AND WITH THREE WAVE FORMS

To study the influence of wave form upon the efficiency of a mercury-arc rectifier, the writer used two

[1] "Experimentelle Untersuchungen am Quecksilberdampfgleichrichter," Technical University of Zurich, 1912. See Figs. 1 and 2.
[2] "Mittelungen der Physikalischen Reichsanstalt," G. Schulze, *Archiv für Elektrotechnic*, 1913.
[3] ELECTRICAL WORLD, June 17, 1916.
[4] See Fig. 4 in writer's article, ELECTRICAL WORLD, June 17, 1916.
[5] See footnote 2. [6] See footnote 2. [7] See footnote 1.
[8] See footnote 3. [9] See footnote 1. [10] See footnote 3.

generators which had approximate sine-wave emfs. that differed only slightly as shown by their equations:

$$e = 142.2 \sin (2\pi nt - 0° 29') + 0.997 \sin (6\pi nt + 9° 30') + 0.341 \sin (10\pi nt - 9° 30') \quad (1)$$

$$\text{and } e = 142.0 \sin (2\pi nt + 0° 23') + 2.19 \sin (4\pi nt - 8° 45') + 2.67 \sin (10\pi nt + 0° 25'). \quad (2)$$

TABLE I—RELATION BETWEEN BULB LOSS, VOLTAGE DROP AND ANODE CURRENT (G. SCHULZE)

I_m is the average value of the anode current; I_{dyn}, which means the current determined by a dynamometer, represents the effective value of the anode current; W_g is the bulb loss determined by method shown in Fig. 1; $W_g/I_m = e$ is the calculated voltage drop; while the last column shows the voltage drop measured directly for different values of anode current.

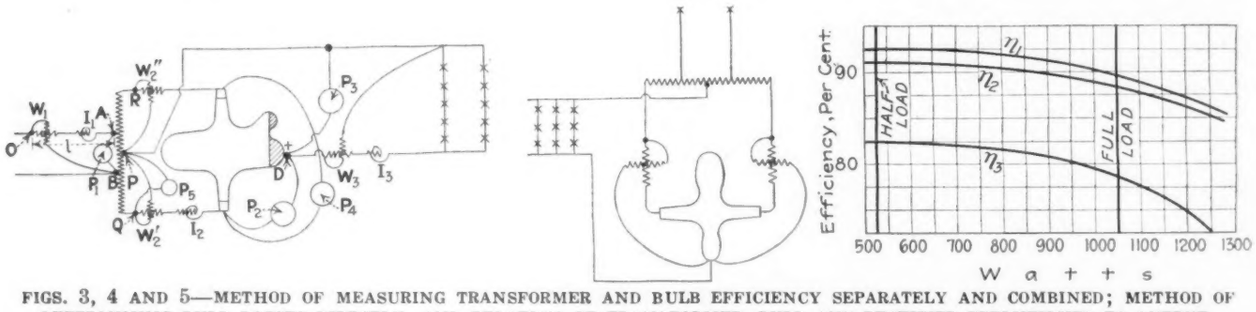
I_m	I_{dyn}	W_g	$W_g/I_m = e$	e
9.45	9.87	99	15.5	15.4
7.09	7.47	110	15.9	15.7
4.96	5.23	114	17.1	16.5
3.27	3.48	128	18.7	17.8

Still the bulb losses differed as shown in Fig. 6 even with constant primary voltage and normal frequency. From these curves it may be noted that for 900 watts output there is a difference in losses of about 7 per cent, despite the fact there is slight difference in the wave form.

This discovery led the writer to believe that the bulb losses, and therefore the efficiency, must be dependent in a high degree on the wave form. To gain more evidence an analysis was made of the anode-current and anode-voltage curves obtained with a contact-maker using the first-mentioned generator. As mentioned in a previous paper, the bulb losses per anode relative to the wave amplitude may be represented by the formula: $W_g/2 = I_0E_0 + \Sigma I_k E_k/2 \cos \alpha_k$, where $K = 1, 2, 3$, etc. For a given anode current and voltage $W_g/2 = 411.3 + 65.8 - 539.2 + 7.7$. The conclusion to be drawn is that the second and third harmonics affect the bulb losses and efficiency considerably.

TABLE II—EFFECT OF FREQUENCY ON BULB LOSSES (G. SCHULZE)

I_m	I_{dyn}	Frequency	W_g	$W_g/I_m = e$
9.64	9.89	18	146.9	15.2
9.76	9.93	30	150.8	15.5
9.45	9.87	50	146.4	15.5
9.76	9.77	100	149.8	15.1
9.51	9.51	500	146.0	15.4



FIGS. 3, 4 AND 5—METHOD OF MEASURING TRANSFORMER AND BULB EFFICIENCY SEPARATELY AND COMBINED; METHOD OF DETERMINING BULB LOSSES DIRECTLY, AND RELATION OF TRANSFORMER, BULB AND RECTIFIER EFFICIENCIES TO OUTPUT

I indicates effective current; P the effective voltage; W power or loss; W' corrected power values. The rectifier input $W_1' = W_c + W_i + W_g + W_3'$, where W_c is the copper loss, W_i the iron loss in the transformer, W_g the bulb loss, and W_3' the corrected output. The bulb output $W_2 = W_1' - W_c - W_i = W_g + W_3'$. W_2 can be measured by wattmeters W_2'' and W_2', making the necessary corrections. The bulb losses are then determined directly by $W_g = W_2 - W_3'$, since both members of the second term are given by the wattmeters. See Fig. 2.

Still another test was made to sustain this conclusion. Three generators with the wave forms shown in Figs. 10, 11 and 12 were used, the bulb losses and bulb and rectifier efficiencies being determined (Figs. 8 and 9) at constant voltage (110) and normal frequency (50) in each case.

As a general observation it might be said that the efficiency of mercury-arc rectifiers is generally estimated

TABLE III—EFFECT[11] ON EFFICIENCY OF INCREASING LOAD WHILE VOLTAGE (110) AND FREQUENCY (50) ARE HELD CONSTANT

$W_1 - I_1^2r$; $W_2' - I_2^2r$; $W_2 + (P_5^2/r)$, and $W_3 + (P_3^2/r)$ are the corrected wattmeter readings; I_1, I_2 and I_3 were measured by dynamometers, and P_1, P_2 and P_3 with electrostatic (Kelvin) instruments. Since a pulsating current (I_2 and I_3) was flowing through the wattmeters, it might be expected that the readings would be influenced by the earth's magnetic flux, but it was found that the effect was very small (0.5 per cent). Neither did frequency have an appreciable effect on the wattmeter readings. η_1, η_2 and η_3 represent the transformer, bulb and rectifier efficiencies respectively.

No. of Lamps	P_1	I_1	W_1	$W_1' = W_1 - I_1^2r$ r = 0.022 Ohm	Cos φ_1	P_4	I_2	P_2	W_2'	$W_2' - I_2^2r$ r = 0.052 Ohm	W_2	$W_2 + \frac{P_5^2}{r}$	W_g	$\frac{W_g}{2}$	P_3	I_3	W_3	$W_3 + \frac{P_3^2}{r}$	I_3P_3	Average of Two Preceding Columns	Efficiency (per Cent) η^1	η^2	η^3
3	110.0	6.10	588	587	0.870	311.5	2.64	211.1	265	265	530	534	45	22	123.8	3.92	482	485	485	485	91.0	91.5	82.6
5	110.0	9.00	860	858	0.866	310.0	4.13	210.6	385	384	768	772	69	35	114.8	6.10	696	699	700	699	89.9	91.0	81.5
7	110.0	11.72	1093	1090	0.847	306.5	5.40	210.0	493	441	982	986	100	50	111.0	7.95	880	882	882	882	90.4	89.9	81.0
9	110.0	14.05	1274	1270	0.822	304.5	6.58	208.4	570	567	1134	1138	129	64	106.8	9.45	1003	1005	1005	1004	89.7	88.6	79.1
11	110.0	16.10	1440	1434	0.810	301.3	7.48	206.5	633	630	1260	1264	156	78	101.9	10.85	1102	1104	1104	1104	88.2	87.6	77.0
13	110.0	18.28	1600	1593	0.792	299.8	8.48	204.3	700	696	1392	1396	189	95	98.8	12.20	1200	1202	1205	1203	87.5	86.5	75.5
15	110.0	20.00	1720	1712	0.778	298.0	9.15	202.0	732	728	1456	1460	212	106	93.8	13.26	1242	1244	1244	1244	85.2	85.5	72.6

[11]See footnote 1.

too high. It is easy to explain why an increase of bulb losses is to be expected if the impressed wave form is

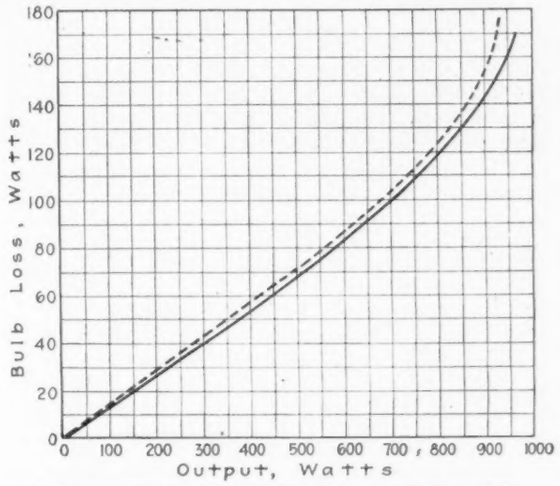


FIG. 6—EFFECT OF WAVE FORM ON BULB LOSSES

(Dotted curve refers to losses with wave form represented by equation (2), while the full-line curve was obtained with the wave form indicated by equation (1). Voltage, 110; frequency, 60 cycles.)

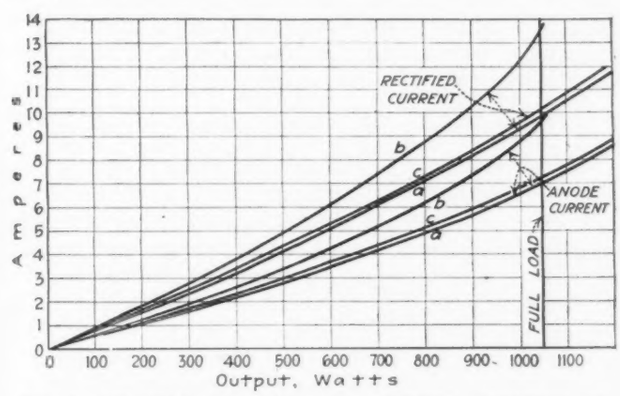


FIG. 7—RELATION OF ANODE AND RECTIFIED CURRENTS TO OUTPUT FOR THREE DIFFERENT WAVE FORMS

quency has no influence on the bulb losses the curves of Fig. 8 are presented. While the relations[12] represented have been questioned by some scientists, their opinions were based on investigations made with direct-current mercury arcs, whereas the data presented here refer

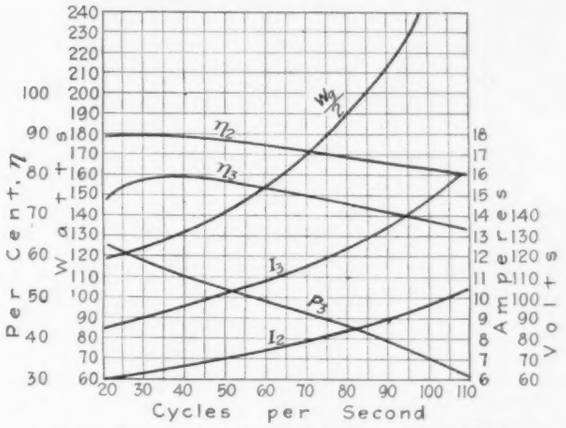


FIG. 8—RELATIONS BETWEEN BULB AND RECTIFIER EFFICIENCIES

(η_2 and η_3) bulb loss per anode (W_g), anode and rectified currents (I_2 and I_3) and rectified voltage (P_3) at different frequencies for a constant normal output (1050 watts) and a constant primary voltage (P_1 = 110 volts).

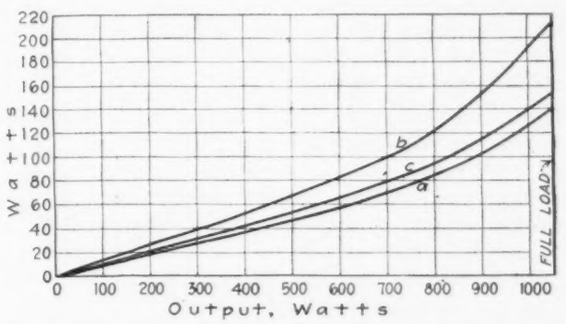
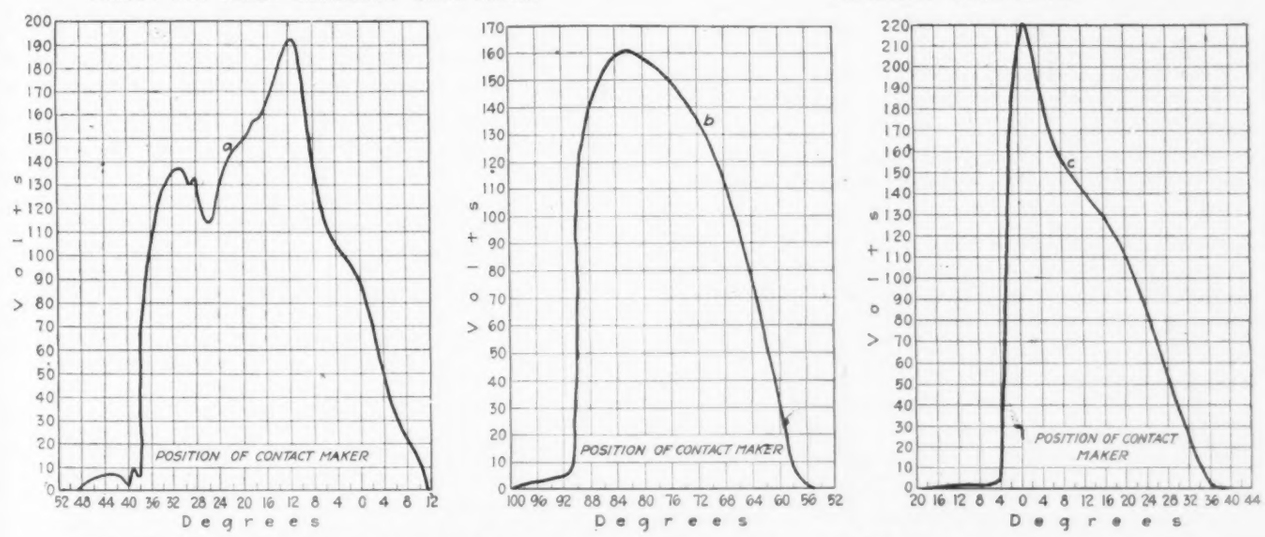


FIG. 9—RELATION OF BULB LOSSES TO OUTPUT FOR THREE DIFFERENT WAVE FORMS

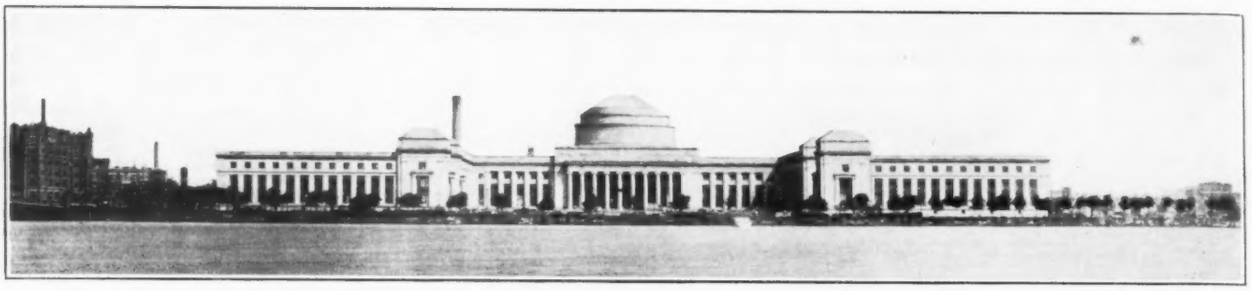


FIGS. 10, 11 AND 12—THREE DIFFERENT WAVE FORMS EMPLOYED TO STUDY EFFECT ON RECTIFIER PERFORMANCE

different from the sine form, because for constant primary voltage the watts loss per anode is $W_g/2 = AI_2^2 + BI_2$, where A and B are constants and I_2 the anode current.

In refutation of G. Schulze's conclusions that fre- to pulsating current mercury-arc rectifiers with which transformers are used that modify the operation of the arc.

[12] *Elektrotechnische Zeitschrift*, 1912, p. 1088; *La Lumière Electrique*, 1912, p. 116; *Science Abstracts*, 1912; *Beiblatter der Annalen*, 1913, p. 608; *Elektrotechnische Zeitschrift*, 1913, p. 254.



Massachusetts Institute of Technology in War

Many Forms of Service to the Nation Are Rendered—Training Technical Men for Land, Sea and Air Activity, Including Duties in Industrial Production

A number of universities are rendering conspicuous service to the nation. Boston "Tech" is especially fortunate in the fine technical organization which enables it to be of notable assistance in the war.

UNUSUALLY varied service is being rendered the United States government by the Massachusetts Institute of Technology in the war. This great engineering university is not only aiding through confidential research work and by the service of graduates under arms, but it is also carrying on an extended program of intensive training to prepare technically qualified men for war service on land, sea and in the air, including duties behind the lines and in communication, transportation and the production of munitions.

For eighteen months before the declaration of war an engineering corps, composed of seniors and instructors, gave time to the study of military engineering at the institute. At the moment war was declared President Maclaurin offered to the United States government the entire facilities of the institute, its faculties and laboratories, pointing out that the use of the latter by a staff familiar with them would be of the greatest advantage.

When war was declared a student committee was appointed to consider the situation and advise the undergraduates as to their most helpful course of action. This committee reported that undergraduates had better "sit tight" and that on graduation they would be worth more to the government than at the time war was declared or while remaining as students. Seniors were advised to seek places where technical men would be of advantage. Summer camps for military work were organized at East Machias, Me., and at Cambridge, Mass., the former, for sophomores, having an attendance of 200, lasting twelve weeks and having uniforms and military routine. The latter camp was for juniors, and in addition to the military work anticipated some of the senior study, to fit the men earlier for national service. The attendance was also 200.

By these means the institute, instead of being "shot to pieces" by the natural excitement and desire to enlist in the ranks, was held together, and last September at the registration nearly 90 per cent of the students were back in school ready again to take up their studies.

Speeding up of the regular courses was undertaken as soon as war was declared, although this development in its highest degree is still under consideration. The vacation courses were to such an extent anticipatory of the senior work that qualified men in the 1918 class were ready for degrees about New Year's, early placing at the service of the government and of industries allied with the war a strong group of competent engineers, young, enthusiastic, well grounded in the fundamentals of engineering practice and not without knowledge of the bearing of such practice on modern war methods.

An All-Year Engineering College

By recent faculty action the institute becomes an all-the-year-round school of engineering, and the lower classes will be advanced toward graduation, not only by the elimination of some of the less important items of study, but also by continuous work throughout the year. In this way the present juniors will be ready for degrees in the fall of 1918, anticipating the normal graduation by about nine months, while the second-year students will be similarly accelerated.

These undertakings on the part of the faculty to prepare enthusiastic students willing to work are based on the belief that the war is to last three or four years longer, and that the Technology student who leaves the institute at the end of his junior year to enter military work is but half an engineer in efficiency compared with what he would be at the end of the fourth-year courses.

At present there are about 2000 regular students in the institute. An advance battalion of senior classmen has been organized and put into khaki, more than 400 men being in the organization. A freshman battalion has also been put into uniform, and a four-year military option has been established in accordance with plans formulated just after war was declared, with the organization of two R. O. T. C. units.

In connection with the latter the institute courses were examined by a commission of army officers, whose report showed that with the addition of a small amount of special military work the graduates of the institute would be of a grade meriting commissions. There have recently been established two units, coast artillery and signal corps, open to sophomores, which will lead direct to commissions. It is hoped to establish two other units, ordnance and engineering, in the near future.

By this action the institute becomes a school parallel with West Point as far as the engineering attainments

are concerned, and equally with the latter a school for the development of material suitable for officers. The faculty has voted to admit freshmen this month, taking a picked group from the high schools graduating in January, who by studying during the summer vacation may overtake the men entering last fall.

On the declaration of war the entire group of students in the naval architecture course and some of the faculty went into the employ of the government or into shipyards. An intensive course in this specialty open to seniors was at once inaugurated, covering eight hours daily for eight weeks. Graduates went into government service and are now performing work of the utmost value in shipyards or in construction work at navy yards. A second intensive course in naval architecture was scheduled to begin on Feb. 4, with an estimated attendance of fifty men.

The faculty has volunteered gratuitous assistance to any seniors wishing to take military examinations by establishing "cram" courses leading up to such tests and many members of the staff have given free intensive instruction during the summer season for patriotic purposes.

Officering the New Merchant Marine

For the United States Shipping Board, Prof. Edward F. Miller, head of the department of mechanical engineering, organized nine schools in principal ports of the United States to educate licensed land engineers in special studies for officering the engine rooms of the new merchant marine. Locomotive and stationary firemen also form the "raw material" of this work. Under the auspices of the institute no less than forty schools for deck officers for the merchant marine have been organized by Dean Burton.

There are now about 2500 "old salts" who have taken the course outlined by Professor Burton and are competent to navigate vessels on the ocean, and more than 1000 men prepared by Professor Miller's schools to care for the motive power of the vessels. Many of these men are already gaining their deep-sea experience in vessels on the Atlantic.

Two aviation schools, one each for the army and navy, have been established, and several hundred aviators have already been trained at Technology in the principles of ground work, bearing in mind in particular the fact that some eight men are required on the ground per flyer to keep the equipment in first-class condition for air service. The institute established the first course in aeronautical engineering in the United States.

Nearly 100 men are also taking an intensive course in a government school for naval inspectors of materials and construction of airplanes and motors, this course being repeated every six weeks.

Plans have also been completed to establish a course in radio engineering for students desiring to enter the United States Signal Corps, open to fourth-year men only. It is expected that the students will be enlisted in the signal corps and placed in Class 5 of the draft list as being in the service of the country. Fifteen weeks of twenty-eight hours each are planned, under the direction of Prof. A. E. Kennelly.

Few details can be published regarding the research work for the government proceeding under the direction of the institute staff, but an important and successful poison-gas investigation has been carried out which appears to rob gas warfare of many of its dangers. It has also become possible to manufacture hydrogen gas in about one-tenth the space formerly necessary, and with correspondingly lighter apparatus —a point of great value in connection with balloon work.

In common with many other institutions, Technology has co-operated with the government in placing accurate and complete lists of its qualified alumni in the hands of Uncle Sam, under the title of "Who's Who in Tech Brains," the list now being in Washington and in the service of the government.

About 1600 Technology men are in military or naval service, including 117 officers in the United States Army. This is said to be more than from any other college. Twelve hundred are officers in training camps or elsewhere. Sixteen Technology men have already died in the service, and more than 2000 men are actively at work in industries allied to the war.

MASSACHUSETTS BOARD SEES STABILITY OF DIVIDENDS

No Occasion for Alarm as to Intrinsic Investment Worth and Permanency of Reasonable Dividends on Approved Shares

In the forthcoming annual report the Massachusetts Gas & Electric Light Commission expresses confidence as to the permanency of reasonable dividends and the intrinsic worth of shares of stock of gas and electric light companies approved by the board, saying:

As the war preparations of the government have progressed and difficulties of transportation, shortage of fuel and increased prices have developed, the vital relation of the gas and electric companies not only to the community but also to the industrial life of the commonwealth has become more clearly manifest than ever before. The necessity for conserving the capital as well as the natural fuel resources of the country has made evident the desirability of tying together the existing sources of power, both steam and water, and so co-ordinating their operation as to utilize all plants to their utmost capacity. Substantial steps in this direction have been taken upon the initiative of different companies involved. More may still be accomplished as necessity and a broader spirit of co-operation develop. In any event the present exigency has amply justified the encouragement given during the past ten years to the important hydroelectric developments supplying power to the industries of the Commonwealth.

The stimulated industrial activity of 1915 and 1916 encouraged many of the electric and certain of the gas companies to make substantial extensions of their plants. The declaration of war found them engaged in or committed to such undertakings, with floating debts representing capital expenditures which had not been permanently financed. The paramount claim of the government upon the financial resources of the nation, the steady increase in interest rates, the correspondingly steady decline in the selling price of gas and electric stocks, and the growth of a feeling of uncertainty and distrust with respect to all public service securities, have embarrassed such companies in making suitable provision for capital requirements. It is gratifying to note that while readjustments in prices and in operating conditions, due to exceptional costs beyond the companies' control and unusual demands for heat and power, have been necessary, yet net earnings have been on the whole well sustained, and no occasion exists for alarm on the part of individual holders of shares approved by the board as to the intrinsic worth of their investments and the favorable prospects for increased business and for the permanency of reasonable dividends.

A Study of Electric Range Efficiency*—II

Results Obtained by Means of Tests Made on Both Open and Inclosed Heating Units with Different Kinds of Utensils, as Well as from Experiments with Ovens of Different Size

BY R. G. KLOEFFLER

Assistant Professor in Electrical Engineering, Kansas State Agricultural College

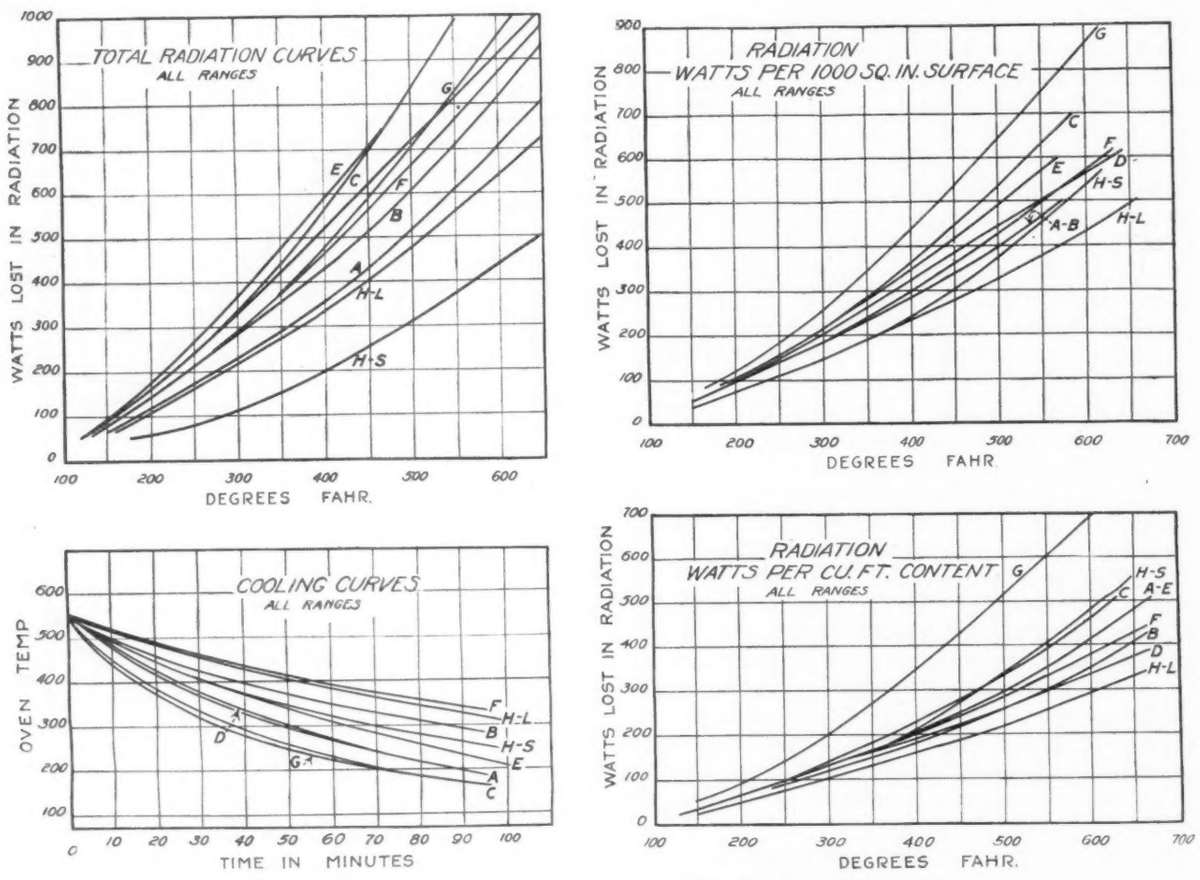
The first installment of this article, printed in the Feb. 16 issue, dealt with the surface-heating units of the electric range. The study of the subject is concluded this week with a consideration of electric ovens.

SINCE the heat insulation of the oven is important, it is desirable to learn the amount of radiation from the oven. To do this a fixed input was given the oven until its internal temperature became constant. This test was made for inputs of 50, 150, 250, 500, 750 and 1000 watts, with current supplied by a storage battery and measured by a wattmeter. The temperature was measured by a carefully calibrated resistance thermometer near the center of the oven.

When the oven temperature became constant at 1000 watts input the circuit was opened, and the temperature was then read at time intervals, giving points for the cooling curve. The time and number of kilowatt-hours required to bring each oven successively to temperatures of 250, 300, 400, 450 and 500 deg. Fahr. (121.1, 148.9, 204.4, 232.2 and 260 deg. C.) was also measured, these being characteristic baking temperatures.

Before comparing the radiation losses of the different ovens it should be carefully borne in mind that these tests were made on ovens of a large variety of sizes, which would affect their total radiation losses materially. Therefore, to make a more just comparison, the radiation of each oven has been reduced to watts per 1000 sq. in. (6450 sq. cm.) inside surface and watts per cubic foot contents, as plotted on the curves of Fig. 5. Table IV gives the exact measured inside dimensions of the ovens and the calculated inner surface area and cubical contents.

In the upper part of Fig. 4 the total radiation curves for all the ovens are plotted. These show, for instance, that at 450 deg. Fahr. (232.2 deg. C.)—a high baking temperature—the radiation varies from 709 watts for large oven E to 258 watts for small oven H-S, while in Fig. 5 it will be observed that the difference in radiation for the same ovens is comparatively small when reduced to unit surface area. Fig. 5 (upper part) likewise shows that the radiation at 450 deg. Fahr. varies from 540 watts on small oven G to 280 watts on large oven H-L when reduced to watts per 1000 sq. in. (6450



FIGS. 4 AND 5—RADIATION AND COOLING CURVES FOR ELECTRIC OVENS

*Copyright, 1918, by R. G. Kloeffler.

sq. cm.), whereas the total radiation of the same ovens shown in Fig. 4 does not differ widely. The ovens A, B, F and H-S and H-L all have radiation losses below 360 watts per 1000 sq. in., or 0.36 watt per square inch. These same four are the lower ones in previous Fig. 4, but the difference there is much greater since the size of oven was not taken into account.

In the lower part of Fig. 5 the radiation has been reduced to watts per cubic foot. Some have contended that this should be the proper basis for comparison, but this is not the opinion of the writer. As a proof of this contention it is pointed out that both H-S and H-L are in same range, are constructed similarly, and should have the same radiation per unit. The comparison by watts per 1000 sq. in. (6450 sq. cm.) shows this to be true, while the comparison per cubic foot places the radiation on H-S near the top and H-L at the bottom, which is not consistent. Both sets of curves agree that the radiation loss on oven G is very high.

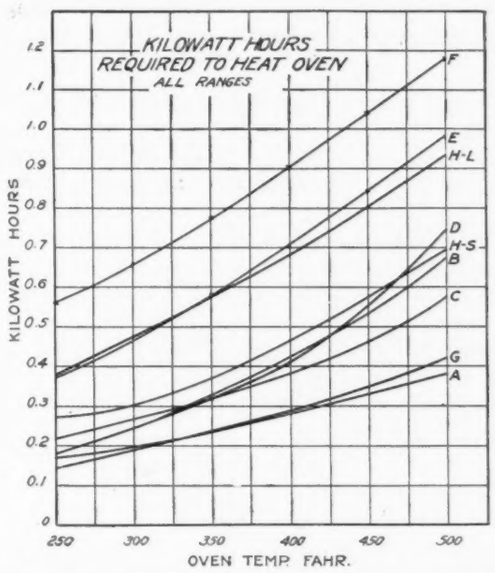


FIG. 6—RATIO OF ENERGY CONSUMED TO OVEN TEMPERATURE

This oven has glass panels in the door, which permits a large heat radiation.

A comparison of the cooling curves is given in the lower part of Fig. 4. Here it might be expected that these curves would fall off in proportion to the amount of radiation as shown in curves of Fig. 5. This would follow if the ovens were of the same size, and does so approximately since ovens C and G, with largest radiation, fall off most rapidly and F, B, H-S and H-L, with smaller radiation, cool much more slowly.

From the analyses made above, it is evident that there is a large difference in the heat-retaining efficiency of the ovens. But judgment should not be based on this alone, since an oven which retains its heat longest may require more energy to heat it than another not so well insulated. This is brought out clearly in the curves of Fig. 6, which show the kilowatt-hours required to bring the various ovens to temperatures from 250 deg. to 500 deg. Fahr. A range of from 1035 kw.-hr. for large oven E to 330 kw.-hr. for small oven A was required to bring them to 450 deg.

It should be observed that the four ovens requiring the most energy to heat are the ones which retain their heat the best or really store it up. Hence for an operation which requires a short time, like baking biscuits, the oven which requires the fewest kilowatt-hours for preheating is obviously the best. Again, for the longer operations, such as baking bread or roasting, the heat-

TABLE IV—INSIDE DIMENSIONS AND CUBICAL CONTENTS OF OVENS

Range	Oven	Inside Area*	Cubical Contents†
A	18 in.x12 ⅛ in.x12½ in.	1,250	1.71
	(45.7 cm.x30.8 cm.x31.7 cm.)	8,060	44.7
B	17¾ in.x17½ in.x12¾ in.	1,520	2.29
	(45 cm.x44.4 cm.x32.4 cm.)	9,801	64.8
C	18¼ in.x16 in.x14½ in.	1,577	2.45
	(46.3 cm.x40.6 cm.x36.8 cm.)	10,175	69.3
D	18¼ in.x18 in.x14 in.	1,612	2.66
	(46.3 cm.x45.7 cm.x35.5 cm.)	10,400	75.3
E	18 in.x18½ in.x14½ in.	1,724	2.80
	(45.7 cm.x47 cm.x36.8 cm.)	11,120	79.2
F	18 in.x18½ in. x12 in.	1,542	2.32
	(45.7 cm.x47 cm.x30.5 cm.)	9,950	65.5
G	19 in.x12 in.x10½ in.	1,118	1.39
	(48.2 cm.x30.5 cm.x26.6 cm.)	7,218	39.1
H-L	18½ in.x15½ in.x13¼ in.	1,474	2.20
	(47 cm.x39.4 cm.x33.6 cm.)	9,508	62.2
H-S	10⅜ in.x11½ in.x13¼ in.	818	9.15
	(26.3 cm.x29.2 cm.x33.6 cm.)	5,380	25.9

*In square inches and square centimeters.
†In cubic feet and cubic decimeters.

retaining oven with lower radiation losses may require less energy and give a more uniform temperature.

To get at this more concretely, a table has been prepared showing calculated kilowatt-hours required to keep the oven within the required range of temperature for a short operation (baking biscuits) requiring a hot oven, a one-hour operation (baking bread) and a two-hour operation (meat roast). Only the energy required to maintain the temperature is given, it being assumed that the heat would be the same in each case.

This table (V) has been prepared from the curves in Fig. 6 with the following assumptions as a basis. About 450 deg. Fahr. is required for baking biscuits and any oven will retain its heat a sufficient time for this operation after reaching 450 deg. Hence the number of kilowatt-hours required to heat it to 450 deg. is taken

TABLE V—KILOWATTS REQUIRED TO PREHEAT AND KEEP OVENS AT PROPER TEMPERATURE

Range Oven	Biscuits, 450 Deg. Fahr., Kw.-hr.	Bread, 400-300 Deg. Fahr., One Hour, Kw.-hr.	Roast, 400-250 Deg., Two Hours, Kw.-hr.	Cubical Contents in Terms of Oven E, per Cent
A	0.330	0.447	0.624	61
B	0.540	0.490	0.645	82
C	0.460	0.680	0.935	87.5
D	0.556	0.662	0.824	95
E	0.840	0.910	1.200	100
F	1.040	0.905	0.905	22.5
G	0.350	0.540	0. 60	49.5
H-S	0.575	0.515	0.585	32.7
H-L	0.810	0.680	0.680	78.5

directly from Fig. 6. Bread will require about one hour to bake, and beginning with 400 deg. Fahr. the temperature may fall to 300 deg. Fig. 6 gives the watt-hours required to raise the temperature of the ovens to 400 deg. Then the cooling curve is consulted, and the

time during which energy must be applied to give an average temperature of 350 deg. is noted. From the radiation curve (Fig. 4) the necessary watts which must be supplied to maintain this temperature can be obtained, and this, multiplied by time and divided by 1000, gives additional kilowatt-hours. This value added to the initial kilowatt-hours gives the total energy required for baking bread. For making a roast a temperature range of from 400 deg. downward to 250 deg. in two hours is assumed, and the same system of computing as for bread is used. Two ovens remained within this temperature range for two hours.

The figures given are not asserted to be exact, but indicative of results achieved under practical conditions.

Table V shows that ovens G and C with large radiation losses are more economical for making biscuits than H with low radiation losses. A and H-S, being small ovens, appear to be most economical for the average of three operations. The large ovens B and H-L show how the low radiation loss makes for economy in the long-period operations.

The advantage of cooking cereals, etc., in ovens as fireless cookers will show most favorably also in the oven having low radiation losses. The last column gives the size of each oven in percentage of the largest oven and will help the reader in making a fair comparison.

A. I. E. E. Convention Papers and Discussions

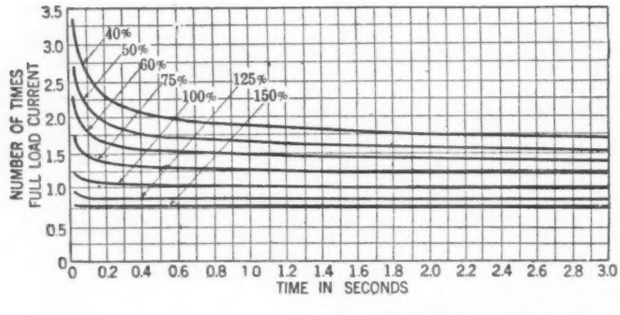
Abstracts of Principal Papers, Including Rating and Selection of Circuit Breakers, Substitutes for Standard Cells, Demand Meters and Dielectric Losses in Cables

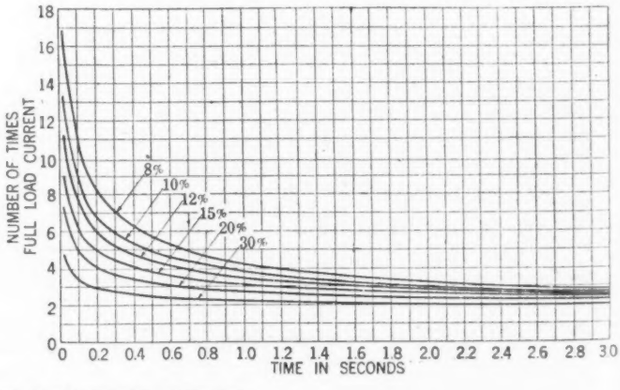
EIGHT papers were presented before the midwinter convention of the American Institute of Electrical Engineers in New York Feb. 15 and 16 that aroused considerable valuable discussion. They were as follows: "Rating and Selection of Oil Circuit Breakers," by E. M. Hewlett, J. M. Mahoney and G. A. Burnham; "A New Standard for Current and Potential," by C. T. Allcutt; "The Thermoelectric Standard Cell," by C. A. Hoxie; "The Character of the Thermal Storage Demand Meter," by P. M. Lincoln; "Measurement of Power Losses in Dielectrics of Three-Conductor High-Tension Cables," by F. M. Farmer; "Commutation in Alternating-Current Machinery," by Marius A. C. Latour; "The Secomor—A Kinematic Device Which Imitates the Performance of a Series-Wound Polyphase Commutator Motor," by V. Karapetoff, and "The Polyphase Shunt Motor," by C. K. Altes.

Rating and Selection of Oil Circuit Breakers

"On account of the variable conditions in systems on which circuit breakers are used, it is impossible to give a simple rule which will cover the selection of circuit breakers for all cases," say E. M. Hewlett, J. M. Mahoney and G. A. Burnham, joint authors of a paper on the above subject. The authors discuss the interpretations of the A. I. E. E. Standardization Rules covering rating of oil circuit breakers and consider the variable factors which are involved in the selection of circuit breakers for various systems.

While the r.m.s. current at any point of a system under short-circuit conditions is affected by numerous factors, practical approximate selection of circuit breakers, sufficiently accurate for many cases, can be made by using only reactance and an accepted group of time-current decrement curves, such as presented here. The curves are based on the following assumptions: Transient characteristics for alternators of normal design are determined from oscillograph tests; effect of capacitance and resistance is neglected; the contact resistance at short circuit is zero; the alternator is carrying full load 80 per cent power factor; the short circuit was established at the point of pressure wave corresponding to maximum possible instantaneous current, and no automatic voltage regulators are used. The curves are applicable for selecting circuit breakers for systems consisting of single or multiple machines with or without external reactance.





CURRENT DECREMENT CURVES FOR AVERAGE SYSTEMS

Ratio of system short-circuit current (r.m.s. amp.) to full load generator current at different intervals after circuit has been opened. The reactance indicated on each curve is based on the total kva. rating of the generators.

To make use of the curves it is only necessary to determine the total reactance between the generators and the point of short circuit, remembering to convert the percentage of reactance in each case to a value corresponding to the total generator rating feeding into

the short circuit. After the total reactance and the time in seconds required for the circuit-breaker contacts to open are known it is possible to read the ratio of the r.m.s. short-circuit current to the full-load current directly from the accompanying curves. Several examples showing the applications of the curves are given in the original paper.

Unless the external reactance is very high, the use of automatic voltage regulators will increase the excitation after a short circuit so much that while the voltage may not be raised even to normal value, the sustained short-circuit current will be increased about 50 per cent. The authors conclude by expressing the belief that manufacturers of oil circuit breakers should publish information similar to that outlined in this paper not only to serve as a guide in the application of electrical protective devices but also to assist in bringing about a more uniform selection and a better understanding of the various expressions and methods used in connection with the rating of this class of equipment.

Discussion

The subject of selection and rating of oil circuit breakers aroused lively discussion, in which the following speakers took part: C. M. Hewlett, J. M. Mahoney, H. R. Summerhayes, W. W. Willard, Bassett Jones, F. C. Hanker, Philip Torchio, P. M. Lincoln, R. F. Doherty, F. L. Hunt, H. H. Dewey, H. D. James, M. L. Pollard, M. J. Neall, E. G. Merrick, C. H. Adams, H. C. Cushing, Jr., and G. A. Burnham.

Mr. Hewlett pointed out that the current-decrement curves shown in the paper were obtained from medium-size and small machines through the co-operation of manufacturers. Later tests will be made to check the accuracy of the curves for machines of higher ratings. He urged standardization of tests on circuit breakers.

Mr. Mahoney, commenting on the suitability of duty as a basis for comparing oil circuit breakers, expressed the belief that the A. I. E. E. specifications for duty are sufficient, as the duty imposed under actual operating conditions is usually less severe than that assumed in connection with the specifications.

Mr. Summerhayes elaborated on the effect of power factor on the rupturing capacity of oil circuit breakers. For instance, at 100 per cent power factor the current and voltage waves pass through zero at the same time, and it is easier for the oil circuit breaker to rupture the circuit than at lower power factors when the current and voltage are never zero at a time. With considerable reactance in the circuits oscillations may be set up which cause transient conditions that are difficult to determine. When resistance predominates switch duty is less severe.

Mr. Willard pointed out that the curves presented in the paper by Hewlett, Mahoney and Burnham cover cases in which all legs of a polyphase circuit are involved, as well as the grounding of one phase. It is possible, he added, that the curves will also cover cases where one leg is grounded, provided only one of the generators in multiple is grounded. Attention is also called to the necessity of considering cases where the grounds occur on the generator side of the transformers as exceptional and not covered by the curves.

Mr. Jones emphasized the need of information which would facilitate the selecting of oil circuit breakers from a variety of different makes. There is no necessity, he pointed out, of having a different type of circuit breaker for every condition, if reinforcing parts are available which can be applied to a few standard makes of oil circuit breakers. By thus making a few types suitable for all conditions, manufacturers would be able to simplify their stock by carrying fewer types of oil circuit breakers, and the users of switches could modify circuit breakers as operating conditions changed by reinforcing the parts.

Mr. Torchio said that no circuit breakers have been found capable of opening short circuits in the proximity of New York generating stations without reactors. He trusted that developments will bring out such a switch. One of the greatest difficulties in selecting oil circuit breakers, he pointed out, is in judging future requirements. Systems change so rapidly that unless a large enough circuit breaker is installed in the beginning substitution of larger units may have to be made too often or reactors will have to be provided to supplement the switch which met former operating requirements but is too small, alone, for present conditions. Large circuit breakers are usually more economical than small units used in conjunction with reactors, but on industrial circuits where proper attention cannot be given to the switches it may be better to use simple switches with reactors.

Mr. Lincoln pointed out the necessity of expressing reactance ratings in terms of current as well as voltage, since a reactor which will have a certain effect with one current will have a different effect with another current. The difficulty which manufacturers have in rating circuit breakers is due to the inability to test them under the user's conditions. Therefore close co-operation between manufacturer and user is necessary if the proper development in circuit-breaker information and construction is to be expected.

Mr. Doherty pointed out that in old machines—that is, those designed several years ago—the sustained short-circuit current is larger than in recently designed machines; therefore the curves given in the paper should be modified accordingly.

Mr. Hunt, in calling attention to the necessity of a more definite method of rating of circuit breakers to permit comparison, suggested that manufacturers give curves showing the effect of different factors on the performance.

Mr. Dewey said that so far circuit breakers have been made which are capable of rupturing 500,000 kva. The development of larger circuit breakers is not so important, the speaker believed, since it is doubtful whether circuit-breaker rating will limit the size of electric systems. It is more likely that damage to buses, etc., on peak values of the short-circuit current will be the limit.

Mr. James called attention to the fact that the impedance of transformers will limit the short-circuit current drawn by motors. Selective operation of oil switches—that is, automatically opening branch-circuit, feeder and generator switches in the order named—will help considerably in solving the oil circuit breaker problem.

Mr. Pollard contended that while the information presented in the paper may help in certain cases in deciding the maximum r.m.s. current which may exist, it does not help in the selection of circuit breakers of different makes. Since further investigation along this line would be of interest to operating engineers, he

suggested the formation of a committee composed of operating engineers and manufacturers to specify standards of comparison. This need was emphasized by Mr. Adams. Mr. Pollard also urged marking current and voltage on all circuit-breaker name plates.

Mr. Neall said that in drafting specifications distinction should be made between the duty which will demolish a circuit breaker and that which will only unfit it mechanically for continued operation. He expressed the belief that the A. I. E. E. should specify what percentage of maximum rating should be allowed in circuit breakers.

Mr. Merrick said that the momentary short-circuit currents for single-phase and three-phase shorts do not differ considerably, but that the sustained single-phase short-circuit current may be 30 to 50 per cent greater than a three-phase short-circuit value, depending on whether a definite-pole machine is used or not. With a definite-pole machine the single-phase short-circuit value obtained with a leg-to-leg short circuit may be 75 per cent greater than with a three-phase short circuit.

There are three duties for an oil circuit breaker to perform, said Mr. Cushing. They are to disconnect a circuit, to carry current and open under abnormal conditions. Therefore, in stating the performance of circuit breakers, it should be pointed out what they can do besides opening under abnormal conditions.

Mr. Mahoney pointed out that it is the expulsion of oil that really limits the duty of an oil circuit breaker, as after a certain number of operations enough oil may be expelled to make extinction of the arc difficult. Furthermore, arcing tips may be consumed, hence it is not desirable to operate without inspection after a certain number of operations.

In closing the discussion on the paper, Mr. Burnham said that standardization of oil circuit-breaker ratings would be very welcome to manufacturers, but at the present time there is no apparatus, to his knowledge, which can be used to determine the effect of factors affecting the short-circuit current on the rupturing capacity of oil circuit breakers. While old catalogs issued by manufacturers of oil circuit breakers may not have been of much assistance to users in selecting the type of equipment used, he expressed the belief that most new catalogs will be serviceable, as they will list the operating and tripping time of the mechanism used with the circuit breakers. Special emphasis was laid upon the necessity of close co-operation between users and manufacturers.

Substitutes Suggested for Standard Cells

Chester T. Allcutt described a new secondary standard which is proposed as a substitute for the standard cell in certain classes of direct-current measurements. The device consists of a Wheatstone bridge which will balance for but one value of current. Various factors affecting the accuracy and permanence of the devices are discussed, and a number of curves are given showing the characteristics which have been obtained. The work done in connection with the development of this new standard has demonstrated that it can be relied upon to maintain an accuracy of 0.1 per cent.

A means of obtaining a secondary standard of emf. by utilizing the emf. of a thermocouple was described by C. A. Hoxie in a paper following Mr. Allcutt's. The method consists in balancing the potential across a resistance against the thermoelectric emf. of the thermocouple. This requires a definite value of current through a filament which is used as a source of heat for the thermocouple. The construction of the cells is discussed in detail, particularly the use of gas in the bulb. The results of permanency tests on a number of cells are shown.

Discussion

In the discussion of the preceding subjects it was brought out by several speakers that while the war has made it exceedingly difficult to secure standard cells, there is no necessity of using high-precision cells for some kinds of potentiometry. Among those taking part in the discussion were Dr. C. H. Sharp, F. C. Stockwell, Dr. E. E. F. Creighton, Dr. P. G. Agnew and the authors of the two papers.

Dr. Sharp described an inexpensive, easily made and convenient standard cell which is being used in the Electrical Testing Laboratories on work not requiring high precision. To secure standard alternating-current or direct-current voltages it is convenient to use a bridge made up entirely of incandescent lamps which will balance on only one voltage.

Mr. Stockwell expressed the belief that the two methods described in the preceding papers fall short of replacing the primary standard cells in simplicity, convenience, accuracy and permanency. He also questioned the value of substituting primary cells, as modified cadium cells can be made very cheaply—for about $3 apiece—and will last about three years. When aged they have almost the accuracy of the primary standard cell.

Dr. Creighton expressed the belief that the value of two substitutes for primary standard cells described in the preceding papers is in connection with alternating current. These cells have been used with frequencies of 100,000 cycles per second.

Dr. Agnew pointed out that the accuracy of the unsaturated type of Weston cell can be made very high by preparing the mercurous sulphate with alternating current. In this connection, he pointed out, the emf. depends upon the frequency used in the preparation of the compound.

Demand Meter That Operates on Thermal-Storage Principle

After giving a detailed description of the principle and construction of the thermal-storage demand meter, P. M. Lincoln showed why it will always indicate what may be called the logarithmic average rather than the arithmetic average of power consumption heretofore indicated by practically all demand meters. The inherent faults of the arithmetic-average or block-interval meter are described and examples given demonstrating that the thermal-storage meter alone recognizes the true heating effect that fixes size of equipment and, therefore, the cost that should be assessed against the customer. The thermal storage-demand meter gives a much higher indication for a very short-time peak-load application than does the block-interval demand meter, thereby making unnecessary the adoption of short demand periods designed to penalize such high peak loads.

Discussion

The suitability of the readings given by thermal-storage demand meters in determining the primary charge assessable to consumers constituted the chief subject of discussion in connection with the preceding paper. Among the speakers taking part in the discussion were the following: C. R. Hall, G. W. Magalhaes, G. L. Hoxie, M. G. Lloyd, A. S. Albright, H. D. James, H. L. Wallau and the author of the paper.

Mr. Hall compared the indications of the Wright, the thermal-storage wattmeter and the thermal-storage ammeter types of demand meters, expressing the belief that the readings given by the latter type more nearly represent the heating effect on the equipment serving a consumer.

Mr. Magalhaes did not favor the standardization of the maximum-demand period, saying that local conditions should fix this value.

Mr. Hoxie expressed the belief that the consumer's maximum demand, which is coincident with the station peak, is the value which should be taken into account in fixing the primary charge, as it is this value which determines the amount of generating equipment which must be kept in reserve to serve a consumer.

Dr. Lloyd agreed that the readings given by a thermal-storage demand meter closely approximate the heating effect produced in a generator supplying a load, when only one consumer is being served, but that under actual operating conditions, where the loads of several consumers are superposed, the diversity causes the maximum system demand to be less than the sum of the maximum demands of the individual consumers. Hence the consumer's maximum demand is not an indication of the amount of the equipment which must be kept in reserve to serve him.

Mr. James pointed out that the chief value of the thermal-storage principle is in indicating the heating effect on individual pieces of apparatus such as motors. Thermal-storage ammeters are particularly valuable in indicating when an intermittent load is overheating a motor.

In closing the discussion Mr. Lincoln contended that heating of electrical apparatus is due to voltage as well as current, therefore a thermal-storage wattmeter type of demand meter should more closely represent heating of the apparatus serving a consumer than an ammeter type of demand meter. Referring to Mr. Hoxie's remark, he said that the distribution expense is relatively larger than the generation expense per consumer, so maximum demand as indicated by the consumer's meter does represent the portion of the total overhead charge which should be assessed against the consumer in the form of a primary charge.

Measuring Dielectric Loss in Three-Conductor Cables

In a paper entitled "Measurement of Power Loss in Dielectrics of Three-Conductor High-Tension Cables" F. M. Farmer described a method used at the Electrical Testing Laboratories for measuring the dielectric power losses in 10-ft. (3.04-m.) samples of three-conductor cables with three-phase potential applied to the cable. Methods of overcoming the difficulties encountered are discussed in considerable detail.

Among the conclusions drawn are the following: The power loss in the dielectric in a three-conductor cable can be readily measured under actual three-phase conditions in the laboratory with specimens 10 ft. (3.04 m.) long; no special apparatus is necessary other than a reflecting high-sensitivity wattmeter; apparently the power loss in the dielectric cannot in all cases be accurately calculated from data obtained in single-phase tests, although it is highly probable that for all practical purposes the discrepancy would not be serious.

Discussion

Reference to dielectric loss tests abroad and in this country, different methods of making the tests, cause of difference between losses as obtained by single-phase and three-phase tests, standardization of tests, limitation of dielectric losses by specifications, precautions necessary in tests, and advisability of testing dielectric losses after cable has been in service were the chief subjects discussed in connection with this paper. Among those taking part were H. W. Fisher, R. W. Atkinson, C. W. Davis, Mr. De Bois, John L. Harper, W. H. Cole, L. L. Elden, Philip Torchio, L. T. Robinson, F. W. Peek, Jr.; Dr. M. G. Lloyd, J. R. Craighead and Prof. C. A. Adams.

Mr. Davis referred to the electrometer, electrodynometer and bridge methods of testing dielectric losses, saying that each had been used by his company.

In trying to account for the difference between loss readings obtained by making single-phase and three-phase tests, Mr. De Bois referred to the shifting of the neutral plane due to phase rotation as possibly affecting the losses. Naturally the center of the cable is hottest, but not necessarily owing to greater stresses. The reason why cables break down in the center more than elsewhere is because the dielectric losses are cumulatively increased by the high temperature existing.

Mr. Cole pointed to the possibility of carrying capacity of cables being limited by part of the dielectric changing in such a manner that other parts are overstressed.

Mr. Torchio showed curves indicating the effect of wave form on the dielectric losses, and urged reducing losses to capacitance and resistivity per unit of volume.

Mr. Robinson pointed out that correction for the phase-angle distortion of a potential transformer can be eliminated by applying a compensating load which can be measured.

Mr. Peek called attention to the advisability of measuring dielectric losses in cables after they have been in service, as the insulating compound may migrate.

In offering a clew to the difference in losses as obtained by single-phase and three-phase tests, Dr. Lloyd pointed out that the dielectric may be stressed differently in the two cases, that the insulation is not homogeneous, that the loss due to an alternating field may be different from that due to a rotating field, etc. Along this same line Professor Adams emphasized the non-homogeneity of cable insulation, and the different effects of single-phase and three-phase currents on the temperature, the losses per unit volume, the specific resistivity and on the flux distribution.

OTHER PAPERS AND DISCUSSIONS

Abstracts of the three remaining papers will be found under "Technical Theory and Practice," on page 420 of this issue of the ELECTRICAL WORLD.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

FIREPROOF COMPARTMENTS FOR TRANSFORMER UNITS

Each Cell Opens Directly Out of Doors—Steel Curtains Provide for Removal or Protection Against Weather as Required

The accompanying illustration shows the provision of fireproof compartments for transformer units which is one of the particular features of a new substation of the Edison Electric Illuminating Company of Brockton, Mass., marking an advance over practice in many older

THIS TYPE OF CONSTRUCTION FOR HOUSING TRANSFORMER UNITS REDUCES FIRE HAZARD MATERIALLY

installations. A separate cell is built for each of the main transformers, each cell opening directly out of doors. Metal roller curtains provide for protection against weather or removal, as the occasion requires. Each transformer is mounted on a reinforced-concrete track, the outer ends of the rails or beams terminating in a concrete sill in which a rectangular slot is left for oil drainage. Adjacent transformers are separated by fire walls through which the necessary connecting leads pass.

ADVANTAGES AND METHOD OF INTERLOCKING MOTORS

Motors Should Be Interlocked When Driving Cutting Machinery Where the Rate of Material Feed Varies

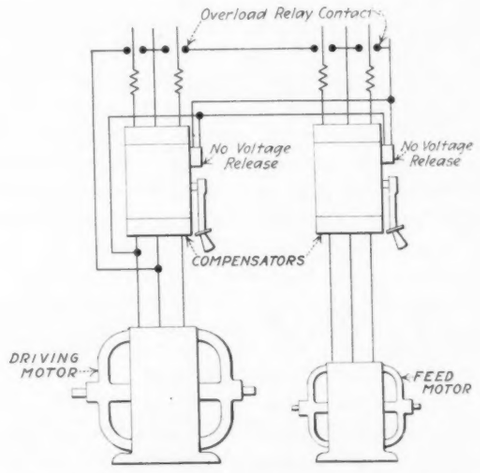
BY DAVID R. SHEARER

In a great many manufacturing operations it is frequently found advisable to drive a given machine by more than one motor. That is, the machine may require more than one motor in order that the different operations of the machine may be changed with respect to other operations of the same mechanism. This is true particularly with cutting machinery, where the rate of material feed should be adjustable in order to handle various sizes of stock. As examples of machinery in which this characteristic is necessary, planers, wood saws, diamond marble saws, sizers and other tools in which the cutting is practically constant but the feed variable may be mentioned.

As long as the cutting motor and the motor operating the variable feed are both running, the entire machine operates satisfactorily, but should the cutting motor blow a fuse, trip its relay or be stopped by the operator and the feeding motor continue to run, serious trouble is liable to follow. The feed will force material against the powerless cutters and either bend or break parts of the equipment. Most feeds operate rather slowly by being geared down many times from the motor shaft, so that the feed motor, though very small, may have enormous power on the slow-moving rolls or carriage handling the material.

Trouble can be obviated easily on any machine operating under power from two or more motors by interlocking the no-voltage-release coils on the starters or compensators. The accompanying illustration indicates a driving and a feed motor operating in an interlocking manner on three-phase alternating current. It will be noticed that current is taken from the driving motor leads through both release coils and both relay trips on the two compensators. Thus, if the cutting or drive motor is stopped or fails, the current is broken in the release coil of the other machine and it stops also. Moreover, if either motor becomes overloaded sufficiently to trip the relays the entire set is at once brought to a stop.

By the addition of a double-throw switch the coil-operating current may be taken from the leads of either



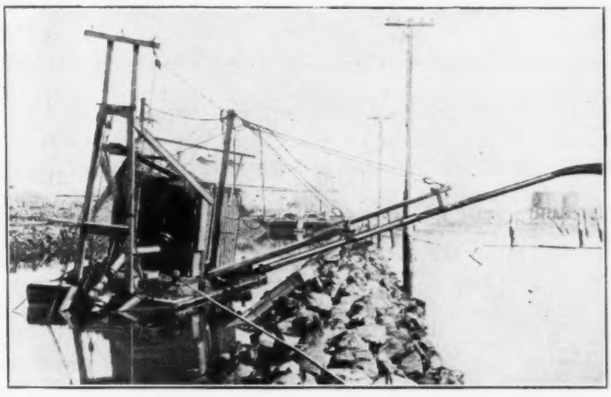
DRIVING AND FEED MOTOR OF CUTTING MACHINERY INTERLOCKED TO INSURE SIMULTANEOUS OPERATION

motor as desired. This is sometimes advisable when it is necessary to operate one of the motors singly for some specific purpose. This method of interlocking may be extended to cover several motors operating interdependent mechanism, and the actual arrangement of connections may be subject to many changes; but the principle remains the same.

ELECTRIC SUCTION DREDGE FOR CONDENSER INTAKE

Rock-Filled Jetties Built to Help Clear Canal of Silt—Details and Cost of Electrically Driven Dredge

The San Diego Consolidated Gas & Electric Company has used with success for a number of years an electrically driven suction dredge for keeping clear the channel in the bay from the condenser intake to deep water. The main intake of the company's steam plant consists of a double concrete tunnel 800 ft. (243.8 m.) long. The lower or intake tunnel is 6 ft. by 3 ft. 9 in. (1.8 m. by 1.1 m.) at the intake chamber and 6 ft. by 4 ft. 9 in. (1.8 m. by 1.4 m.) at the power house. The discharge tunnel is 6 ft. by 6 ft. (1.8 m. by 1.8 m.). The intake chamber is 23 ft. by 20 ft. (7 m. by 6.1 m.). The intake chamber is situated on San Diego Bay near the foot of Ninth Street. From the intake chamber a canal was dredged, perpendicular to the shore line at this point, in a southwesterly direction. This dredged canal is about 800 ft. (243.8 m.) long and reaches to a deeper part of the bay. Owing to the silting up of the canal



ENERGY FOR DRIVING MOTOR SERVED THROUGH CABLE CONNECTED TO NEAREST POLE

with mud and débris it was necessary to dredge frequently in order to obtain sufficient circulating water at extreme low tide. For this purpose an electric suction dredge was constructed and was used with good effect several times a year. More recently the company has lined the sides of the canal with a pair of rock-filled jetties which carry the intake out to the United States government bulkhead line. The center lines of the jetties are 54.2 ft. (16.5 m.) apart.

What Experience with the Dredge Has Shown

Since the jetties were installed the canal silts up far less rapidly than before, little silt being carried in from the sides; for although the tops of the jetties are below extreme high tide, it was only at low tide that much silt and débris was formerly carried sideways into the canal. Not only has the installation of jetties reduced the frequency and cost of dredging, but as the discharge water cannot flow back into the intake canal at low tide, lower temperatures of circulating water are obtained and plant efficiency is consequently improved. Likewise the water is cleaner, thus reducing the expense of cleaning intake screens and condenser tubes. The jetties are now used as a dumping ground for waste brick and similar scrap from about the plant and are in consequence gradually being increased in height.

At present it is necessary to dredge the canal annually. This is usually done just before the extreme low tides of the fall. The barge used for the dredge is a 15-ton lighter, 10 ft. (3 m.) wide by 31 ft. (9.4 m.) long. The pump is a United Iron Works 6-in. (15.2-cm.) centrifugal sand and gravel pump with renewable brass wearing rings in the hubs and with shaft covered with brass tubing. The pump is direct-connected to a 35-hp., 220-volt, three-phase, 60-cycle, 600-r.p.m. induction motor. The dredge is equipped with a house to cover motor and pump and with booms for handling suction and discharge lines. The mooring lines are handled by means of midget windlasses. The suction pipe is 6-in. (15.2-cm.) wrought iron; the discharge pipe a piece of 7-in. (17.7-cm.) pipe, 24 ft. (7.3 m.) long, made of No. 16 galvanized iron, light weight being desirable at this point. No cutter is used. The suction pipe is lowered until it rests on the bottom, and as the dredge is warped lengthwise along the canal a good cut is made in the soft mud and gravel.

The dredge is served by means of a line of 40-ft. (12.2-m.) poles bolted to piles driven just outside of one of the jetties. A three-wire cable carries 220-volt, three-phase energy from the nearest pole to the dredge. The poles also serve to carry lamps for the illumination of the jetties and the protection of small boats in the bay.

The cost of the dredge was as follows:

Lighter	$150
Pump	390
Motor	440
Booms, piping and housing	120
Tools and equipment	155
Wiring	35
Labor	160
Total	$1,450

At present prices the cost of a similar dredge would of course be considerably greater.

UNINTERRUPTED PRODUCTION VERSUS CIRCUIT PROTECTION

Circuit Breaker Is Adjusted Near to the Current Capacity of Circuit and Fuse of Much Greater Capacity Used for Short-Circuit Dangers

BY E. C. PARHAM

When a fuse of low enough capacity to protect apparatus from the effects of ordinary overloads is used, frequently recurring violent fluctuations of current will blow the fuse so often as to interfere seriously with the production of the motor that the fuse is used for protecting. If a larger fuse is used the circuit may be damaged. With a circuit breaker it is much more practicable to adjust to the safe continuous-current capacity of the circuit because the very short time required for resetting a breaker does not seriously affect production. Owing to the general neglect of circuit breakers, however, and to the common but reprehensible practice of abusing their adjustment, it is a wise precaution to include in the circuit a fuse that can be depended on to act under short-circuit conditions should the circuit breaker fail to do so. That circuit breakers can be criminally abused is illustrated by the following experience:

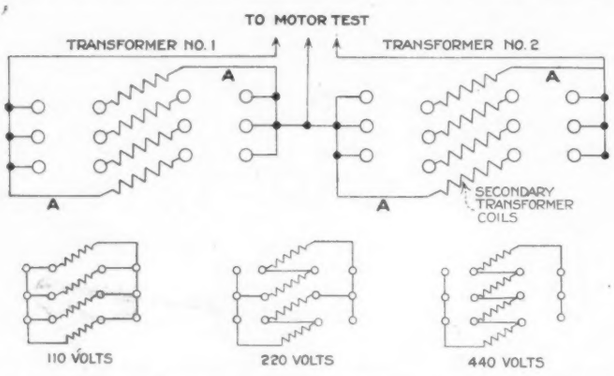
The output of a certain station generator was passed through a double-pole circuit breaker that was con-

nected in series with fuses. As the demand on the station increased another generator was installed, and further increase of load made it necessary to screw up the circuit-breaker adjustment because frequent blowing of the breaker was interfering with the service. Then the fuses began to blow and heavier fuses were installed. Meanwhile the breaker parts were turning blue from heating. To relieve this condition the operator connected a switch in parallel with the breaker and the switch parts immediately began to discolor. Finally the breaker exploded.

SWITCHING ARRANGEMENT FOR TESTING MOTORS

Installation Includes a Pair of Transformers Having 110-220-440 Volt Secondaries and Single-Throw, Single-Pole Switches

The arrangement of switches shown in the accompanying figure will be found useful in motor repair shops for testing purposes. By means of this arrangement single or three-phase 110, 220 or 440-volt energy



A SWITCH ARRANGEMENT THAT WILL BE FOUND USEFUL FOR TESTING MOTORS IN REPAIR SHOPS

may be tapped from a pair of transformers connected in open delta, merely by switch operation, thus saving considerable time in changing connections to suit the various motors under test.

The installation requires a pair of transformers having 110-220-440-volt secondaries. Such transformers are sometimes constructed with eight secondary leads, sometimes with only four. In the latter case four special leads must be brought out, as it is necessary to have access to both terminals of each of the four secondary coils. The extra leads can be readily brought through porcelain bushings placed in holes drilled in the transformer covers.

It will be noted that the full capacities of the transformers are utilized at the standard voltages. In addition, a variety of single-phase voltages are obtainable across the outside leads for special testing by connecting the two transformers for different voltages.

This switching combination is not foolproof. Either transformer may be short-circuited by incorrect connections, but the arrangement is so simple that any tester soon becomes accustomed to it.

Standard single-pole, single-throw knife switches are installed, but half of the switches are used double-throw. If the handles of the switches which are used double-throw strike the bases of the others, the handles may be offset to clear laterally. The installation may be somewhat improved by the insertion of additional single-pole switches at points *A*, although these are not absolutely essential.

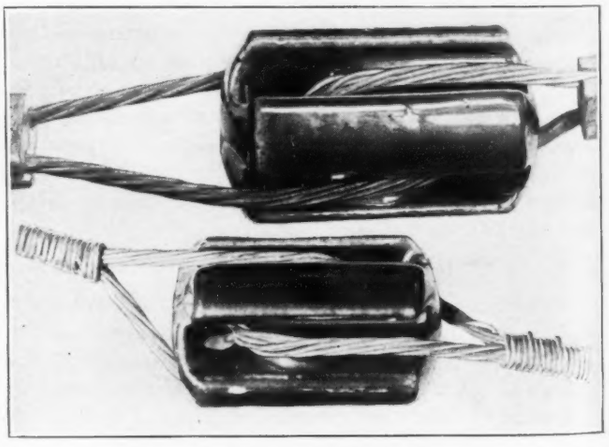
THE PROPER INSTALLATION OF STRAIN INSULATORS IN GUYS

Results of and Conclusions Drawn from Tests Made on the Proper Placing of Clamps Adjacent to Insulators

In making up strain insulators in guys, particularly where large insulators and three-bolt guy clamps are used, care must be taken to place the clamps close to the insulators if the full strength of the guy cable is to be developed. A number of samples were recently made by a Western company and tested for tensile strength. The edges of the clamps were set about 3 in. (7.6 cm.) from the end of the insulator, as appeared to be customary with the linemen making up the samples. It was found that in every case slippage occurred at from one-half to three-quarters of the full strength of the guy, first one clamp and then the other slipping down to within 1 in. to ¾ in. (2.54 cm. to 1.9 cm.) of the face of the insulator, after which each would hold and the sample would develop the full strength of the guy cable.

In the accompanying illustration (upper) a sample is shown under test after one clamp has slipped but before the other had let go. In this particular sample slipping began at 3300 lb. (1496 kg.), and the strand—5/16-in. (8-mm.) seven-strand standard steel—finally broke, after the second clamp had slipped up, at 4400 lb. (1996 kg.). The same results were indicated with lighter guys and insulators made by wrapping without the use of clamps. A good specification covering this point is to make sure that the space between the insulator and the clamp (or wrapped splice if used) does not exceed 1 in. (2.54 cm.).

With respect to the relative values of three-bolt



CLAMP ON RIGHT HAS SLIPPED; SPLICED-IN INSULATOR AFTER BOTH SPLICES HAD SLIPPED

clamps as compared with wrapped splices, the tests indicated that the use of clamps increased the ultimate strength from 15 to 20 per cent, although in all cases the samples, whether made up with or without clamps, exceeded the rating of the steel cables. The lower illustration shows a spliced-in insulator after both splices had slipped.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CENTRAL STATIONS FIND WAYS TO SELL THRIFT STAMPS

Efforts Are Made Successfully to Interest Customers and Employees in Small Savings for the Government Use

Interesting details are coming in of the success which central stations throughout the entire country are having in the sale of war saving stamps. Public utilities have been particularly invited by the government to become authorized agents for the sale of these thrift stamps and war saving stamps and have responded with enthusiasm. Most of the large holding companies have sent out a call to all their properties to line up in the movement and, with the independent companies, have been enrolled direct from Washington. Many ingenious methods are being employed in promoting the sales. For instance:

What the Cashier Can Do to Help

In the office of the Colorado Springs Light, Heat & Power Company—and this idea is now being generally employed—whenever a customer pays a bill at the cashier's window and the change he is to receive is 25 cents or more the cashier suggests that he receive a thrift stamp in place of the 25-cent piece. War saving stamp posters are conspicuous in the office, and the salesman on the floor endeavors to interest every customer who comes in in the purchase of war saving stamps as well as appliances.

The Massillon (Ohio) Electric & Gas Company has made a feature of a large "W. S. S." banner which has been hung in front of the office window. In the early days of the campaign there were a great many inquiries as to the meaning of the initials, and members of the new-business department saw to it that this reacted in the purchase of thrift or war saving stamps. The Massillon company gave each of its employees a partly filled thrift-stamp book as a Christmas gift, and this was done by many other companies at Christmas time.

The Danbury & Bethel Gas & Electric Light Company contributes a Christmas bonus each year to its employees and last Christmas paid the money in thrift stamps.

The Salina (Kan.) Light, Power & Gas Company has made a practice of presenting some small heating appliance to its employees as a Christmas gift. This year it was a war saving stamp or thrift stamps instead.

In Bloomington, Ill., the Union Gas & Electric Company acted so promptly that it was the first authorized agent for the sale of war saving stamps in the community except, of course, the post office. This was commented on extensively by the local newspapers and produced considerable local publicity not only for the company but for the war saving stamps.

The New Orleans Railway & Light Company organized a special campaign for the sale of war saving stamps for its employees. They designed an elaborate window display as a central feature, and prizes were given to the employees selling the most stamps.

The Montgomery (Ala.) Light & Water Power Company has featured a special advertising campaign to push the sale of war stamps in the name of the company and has developed a large sale for these stamps. It has made the slogan of its campaign, "Ask for your change in thrift stamps. A quarter to Uncle Sam means no quarter to the Kaiser."

The Toledo (Ohio) Railway & Light Company, in addition to carrying "W. S. S." posters both inside and outside the street cars and placing them on sale in the office, carhouses, shops and power houses, has stocked each representative of the new-business department with war saving stamps to be sold to present and prospective customers on whom he calls.

The Empire District Electric Company of Joplin has introduced another innovation by offering a thrift card with $1 worth of stamps as a premium to any one who purchases an electric washing machine, a vacuum cleaner or a sewing-machine motor.

One of the most interesting ideas for selling the stamps has been originated by the Manhattan & Queens Traction Company, which operates in New York City, and it will be of interest to central stations operating railway lines. This company has placed thrift stamps on sale in every one of its street cars. Posters are displayed inside the car, and passengers are requested to take their change in stamps wherever the amount is large enough. This has produced a surprising number of sales.

Making It Easy to Pocket the Stamps

In the New York office of the Henry L. Doherty Company impetus has been given to the purchase of war saving stamps by employees by discontinuing the distribution of salary checks and having every employee call at a special window for his check. Here an attractive young woman undertakes to induce every employee to buy at least one thrift stamp, and her efforts meet with much success. At the war saving stamp window in the Doherty office it has been found of great assistance in the sale of stamps to have on hand small square sheets of oiled paper for wrapping up the stamps and little envelopes in which to inclose them. Many a man will hesitate to buy one stamp because he has no place to put it. His thrift card may be at home, and if he puts a loose stamp in his pocket it is liable to be damaged.

The spirit in which the central-station industry is supporting the government in this campaign is undoubtedly developing a large additional market for war saving stamps, and with every member of the organization from the office boy up enlisted in the work it will render increasing service in the effort to raise two billion dollars for the war in this way.

ANOTHER COMPANY STOPS FREE DELIVERY OF LAMPS

Outlying Lamp Service Stations Are Installed and 35-Cent Delivery Charge Is Established in Chicago

The Commonwealth Edison Company of Chicago, which includes free lamp renewal as a part of its service, stopped gratuitous distribution of the lamps on Jan. 15. At the customers' requests lamps were formerly delivered free of charge anywhere in the city. Under the present arrangement when a customer calls at the lamp service bureau the clerk states that the company has, for the convenience of its customers, established lamp service stations in various parts of the city and gives the person who calls the address of the nearest station. The customer is also told that there is a complete stock of lamps at this station and that an attendant there will help him select the proper sizes of lamps. For those who do not wish to call at the stations for lamps the company still maintains a delivery service, for which it charges 35 cents per call.

The lamp renewal stations, of which the company now has twelve, usually occupy space in stores that are already established. This number of stations will probably need to be increased. In selecting these stores it was suggested that real-estate agencies might be desirable concerns to carry the lamps, since they have to maintain stores and have nothing in the way of stock to occupy their windows. On reconsideration, however, it was decided that the most desirable locations for the lamp renewal stores were places of business which had something to gain by having electric service customers call for lamps. The twelve agencies are located as follows: One printer's store, one electric fixture store, one building formerly vacant, three hardware stores, two drug stores and four buildings already partly occupied by the company. This arrangement gives one store to each zone of 2½ miles to 3 miles (4 km. to 4.8 km.) in the city.

An analysis of 1000 calls for lamps made just after the new system was installed showed that about 10 per cent of the customers would rather pay the 35 cents charge than call for lamps in person. This ratio is expected to decrease, however, as familiarity with the system increases.

PATRIOTIC ACTIVITIES OF CENTRAL STATIONS

Carrying Out a Vigorous Policy in Patriotic, Civic and Other Public Enterprises Is Considered Important

H. H. Harrison, president of the Merchants' Heat & Light Company, Indianapolis, Ind., is firmly of the belief that "the public utility which serves its public serves itself." This motto, it is thought, applies in time of war as well as peace. In consequence the Merchants' company has been particularly active since war was declared in conducting such patriotic and civic activities as deserved support under the circumstances. Its efforts in soliciting Christmas presents for the French children in co-operation with the French Relief resulted in 18,000 presents being sent to France. Of late the company has been engaged in promoting food conservation and in fostering a movement for sending comic valentines to American soldiers in France. The latter endeavor had a twofold purpose. The valentines were from the works of Indiana's best caricaturists and authors and will certainly bring smiles to the faces of Hoosier soldiers who receive them. Then, too, the proceeds of

FIG. 1—WINDOWS CONTRASTING AMERICAN AND FRENCH CHILDREN'S CHRISTMAS TO AID RELIEF WORK

the sale of valentines go to the French Relief. The show windows of the Merchants' company office and store, being on the most prominent corner in Indianapolis, have formed a valuable asset in advertising these

FIG. 2—CENTRAL-STATION WINDOW THAT SELLS VALENTINES TO ENTERTAIN SOLDIERS AND PROVIDE RELIEF

campaigns. Some of them are shown herewith. The company's motograph sign on top of the building was considered so valuable in advertising this sort of work that it was especially exempted from all lightless night orders by the local fuel administrator.

KEEPING IN TOUCH WITH OPINION OF CUSTOMERS

Method Designed by Syndicate to Prevent Unfavorable Public Impression from Gaining Headway in Communities Served

One of the big problems of companies serving a number of communities is that of knowing definitely the opinion of the communities toward the company. The general headquarters containing the office are as a rule not in the small towns, but rather in some large city in the same general section of the country. In each of the communities served the company is represented by a local manager or a lesser employee, with whom the local public may or may not be in accord. Owing to the comparatively small amount of time the major officials of the company can devote to any one town, a long period may elapse before any public antagonism toward the company will be found out, unless it is reported by the local representative himself. In most cases the representative probably does make such reports promptly. It is the instance in which no such report is made that causes trouble, for once unfavorable public sentiment is established it is an expensive procedure to change it.

YOUR
SUGGESTION BOX
BUSINESS resolves itself into a matter of dealing with friends.
"A FRIEND," says Emerson, "is a person with whom I may be SINCERE."
WE WANT YOU to be perfectly sincere with us, just as we aim to be perfectly sincere with you. To keep pace with the growing needs of this community, we must come into close relations with you—we must know your requirements, your opinions, your wants.
WE THEREFORE INVITE your frank recommendations and criticism.
IF YOU HAVE any suggestions for the further upbuilding of our service, or if you have any report to make whatsoever—whether in the way of claim, complaint or commendation—you will be doing us a favor if you will pass it on in writing over your signature.
TO MAKE THIS EASY as well as confidential for you, we are posting a Suggestion Box in the local office. We ask you to make frequent use of this "Special Delivery" service, and to accept in advance our assurance of careful and courteous attention to your communications.
ONLY THE OFFICERS of the Company will have access to this box, which is to be opened by them periodically, on the occasion of their visits to this station.
LET US HAVE YOUR CO-OPERATION in making this new plan bear good fruit for you and us alike.
INDIANA
POWER & WATER CO.

SUGGESTIONS DIRECTLY FROM CUSTOMERS TO OFFICERS ARE SOLICITED

Realizing the facts in this situation and wishing to keep in close touch with the opinions of its customers, the Utilities Development Corporation of Chicago has established a system of keeping its officers and its customers in more frequent direct communication. At each city served by the company suggestion boxes have been installed. While the suggestion box idea in itself is not new, this company's method of adapting the idea to its needs is something unique. The printed form reproduced herewith is used in connection with each box. As will be observed the spirit of the announcement is one of absolute fair-dealing. To eliminate the hesitancy any customer might feel about making a suggestion that would be counter to the known ideas of the local representative, the statement is made that "only the officers of the company will have access to this box." This statement is made in such a manner, however, as not to reflect lack of confidence on the part of the company in its local employees. Therein, it is thought, is the strong feature of this printed announcement. It invites the direct dealing of customers with the company's officers without reflecting discredit on the company's employees.

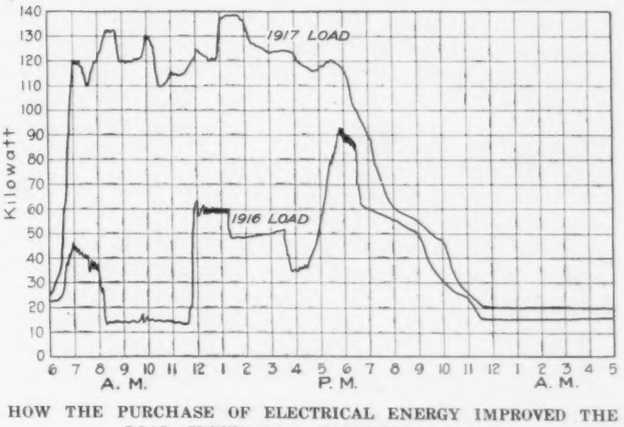
BUYING ENERGY A BENEFIT TO A MUNICIPAL PLANT

Difficulty in Handling Peak Diminished and Load Factor Greatly Increased by Purchase from Power Company

BY J. E. MELLETT
Georgia Railway & Power Company, Atlanta

An example of the benefits derived by a municipal plant through the purchase of energy from the power company will be noted by referring to the accompanying load curves for this class of business. Before this municipality contracted for energy its plant was inadequate for the city's needs, and more or less difficulty was experienced in handling the regular evening peak which is characteristic of all small municipal plants. All new business was discouraged, electrical stagnation existed, and the load factor was approximately 24 per cent.

After connecting to the Georgia Railway & Power Company's high-tension system there were no limiting features, and the load curve taken in 1916 showed that the load factor was increased to 29.6 per cent. The jagged appearance of this curve in the morning, at noon and early evening was caused by a three-phase elevator motor in the only up-to-date office building in the city. A load curve taken early in 1917 indicated that the load factor was increased to 40.5 per cent. Recent maximum-demand indications taken on this plant, together with data on energy consumption, show that a load factor of 46.5 per cent was attained for 1917.



HOW THE PURCHASE OF ELECTRICAL ENERGY IMPROVED THE LOAD CURVE OF A MUNICIPAL PLANT

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Getting Good Commutation with Alternating-Current Machinery.—In discussing commutation in alternat-current machinery, M. C. A. Latour says perfect commutation in a continuous-current motor depends substantially on the production of a mean resultant neutral field in the region where commutation is taking place. He then goes on to show that the production of a perfect revolving field in a polyphase commutator motor assists in insuring perfect commutation at exact synchronism. In a single-phase commutator motor a polyphase revolving field can be produced at synchronism by utilizing supplementary brushes, short-circuited upon themselves, displaced by 90 electrical space degrees from the main single-phase brushes on the commutator. As in the case of polyphase motors, the problem of securing perfect commutation at synchronism becomes that of producing a perfect rotating field. The use of fractional-pitch windings on the rotor and a sinusoidal distribution of conductors on the stator is of much assistance in this connection. In a motor built in accordance with the principles set forth the commutator difficulties are not serious, the overload range is in excess of that of an induction motor, and the machine can act as a condenser on the system, when operated above synchronous speed. When alternating-current polyphase commutator machines are working above or below synchronism it is necessary in judging the commutation to take into consideration the emf. produced by the resultant field of the stator and rotor in the short-circuited winding sections. If a machine is intended to have the greatest possible range of speed, then it is essential to arrange things so that synchronism corresponds to a speed of perfect operation so far as commutation is concerned.—*A. I. E. E. Proceedings*, February, 1918.

Analysis of Adjustable-Speed Alternating-Current Motors.—Discussing the polyphase shunt motor, W. C. Korthals Altes points out that there exists a demand for a reliable adjustable-speed alternating current motor and then goes on to analyze the advantages and disadvantages of different types now available. For instance, the neutralized motor with shunt-field control is not practicable for commercial frequencies on account of the expensive control equipment required. The induction motor with a commutator on the secondary side is suitable for large outputs, but the control is still too complicated to make this motor suitable for the smaller machine-tool drives. The induction motor with commutator on the primary side offers the best solution for machine-tool motors. The theory of its operation is discussed in detail, and a complete description is given of the mechanism required to shift the brushes and of the new type of armature winding used.—*A. I. E. E. Proceedings*, February, 1918.

Kinematic Device for Imitating Performance of Alternating-Current Machines.—A device consisting of four movable bars of adjustable length which is used for the purpose of imitating the performance of a series-wound polyphase commutator motor is described by Prof. V. Karapetoff in a paper entitled "Secomor." The bars can be set in a combination to represent the vector diagram of voltages in a motor with any desired constants. By moving the bars to vary the load complete performance characteristics of the motor can be obtained, including speed, torque, power factor, etc. An additional mechanism permits taking into account the impedance drop in the machine. An adjustable saturation curve made of soft wire is used in conjunction with the device to enable one to investigate the effect of saturation. Preceding the description of the "secomor" is a discussion covering the fundamental theory of operation of series-wound polyphase commutator motors.—*A. I. E. E. Proceedings*, February, 1918.

Traction

Use of Iron Transmission Wires for Alternating-Current Railroads.—W. KUMMER.—Because of the shortage of copper, Swiss engineers have studied carefully the practicability of using iron cable in place of copper for the overhead contact wires on railroad systems. Dr. W. Kummer, a Zürich engineer, calls attention to the fact that the successful use of iron for third-rails has caused engineers to underestimate the difficulty of using iron for the overhead contact lines. The large cross-section of the rail offers far less resistance to the returning current than the smaller aerial wire, the proportion being about one to twenty. Furthermore, old tests and calculations regarding iron wires were based on direct current and not on alternating. Voltage losses with the latter are far greater, as will be seen from an examination of Fig. 1. Taking the maxima of the various curves in Fig. 1, and plotting a new curve with them, the diagram in Fig. 2 is obtained. At the end of a series of equations and formulas, covering large-dimension rails and small-diameter wires, the author finally leads up to a table in which are shown the differences between copper and iron wires as regards voltage losses per kilometer on overhead transmission lines of 50, 100 and 150 sq. mm. cross-section. The rails used were the regular standard Swiss SBB

TABLE I—VOLTAGE DROP IN RAILS AND COPPER WIRES FOR ALTERNATING CURRENT PER KM. PER AMP.

Cycles per Second	Wire of 50 Sq. Mm.			Wire of 100 Sq. Mm.			Wire of 150 Sq. Mm.		
	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total
0	0.35	0.00	0.35	0.19	0.00	0.19	0.13	0.00	0.13
15	0.38	0.21	0.45	0.22	0.22	0.31	0.16	0.22	0.28
25	0.40	0.34	0.54	0.24	0.36	0.43	0.19	0.36	0.40
50	0.46	0.62	0.78	0.34	0.65	0.71	0.24	0.66	0.70

I-type, weighing 45.93 kg. per meter. The value $E\rho$ represents the voltage drop in the overhead wire, $E\sigma$ represents the drop in the rails, and E total = $\sqrt{E\rho^2 + E\sigma^2}$. As a result of these studies, Dr. Kummer looks with interest but with great apprehension upon the attempt to use iron wires for overhead contact lines. The only suggestion which he makes is to subdivide the overhead wire, similarly to the wires in a wire rope, and then to design some new type of contactor which would be effective on such lines. A number of small-diameter wires would reduce the values $E\sigma$ and E total considerably below those given in Table II.—*Schweizerische Bauzeitung*, Dec. 22, 1917.

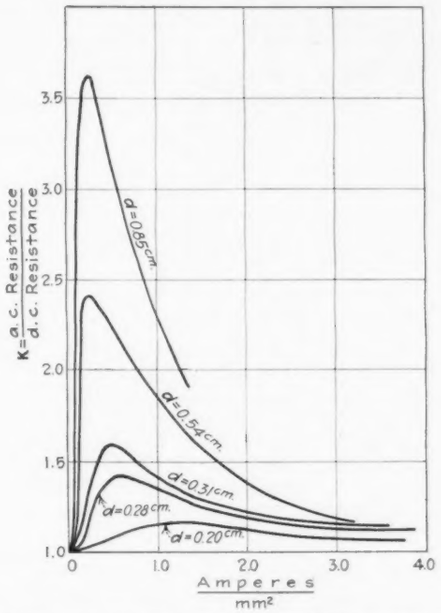


FIG. 1—RATIO OF A.-C. TO D.-C. RESISTANCE FOR DIFFERENT-SIZE IRON WIRES AND CURRENT DENSITIES

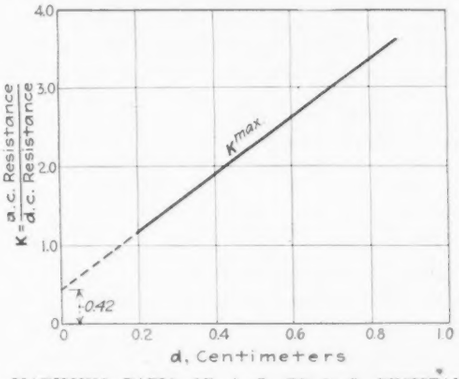


FIG. 2—MAXIMUM RATIO OF A.-C. TO D.-C. RESISTANCE FOR DIFFERENT-DIAMETER IRON WIRES

TABLE II—VOLTAGE DROP IN RAILS AND IRON WIRES FOR ALTERNATING CURRENT PER KM. PER AMP.

Cycles per Second	Wire of 50 Sq. Mm.			Wire of 100 Sq. Mm.			Wire of 150 Sq. Mm.		
	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total	$\epsilon\rho$	$\epsilon\sigma$	ϵ Total
0	2.62	0.00	2.62	1.32	0.00	1.32	0.88	0.00	0.88
15	6.52	1.03	6.60	4.40	1.03	4.51	3.50	1.04	3.65
25	7.49	1.54	7.64	5.02	1.55	5.25	4.06	1.55	4.23
50	9.14	2.22	9.40	6.20	2.23	6.60	4.94	2.25	5.42

Generation, Transmission and Distribution

Subdivision of Waterfalls in Hydroelectric Practice.—F. PAGLIARO.—There are cases, the author holds, where instead of carrying water power through one conduit to a central point of operation it is more economical to subdivide the total fall into a series of smaller falls, with a corresponding series of operating stations. Stating the various factors of cost that enter into such a calculation, he cites a case where the flow is 15 cu. m. a second and the drop (300 m.) uniform for a distance of 3 km. For a development with one central station these figures of cost are arrived at by the author:

	Francs
Conduit	3,870,000
Central-station building	50,000
Equipment	100,000
Total	4,020,000

With the fall divided into two the figures are thus given:

	Francs
Conduit	2,210,000
Two central-station buildings	100,000
Equipment of first station, including transformer	250,000
Equipment of second station	100,000
Transmission line between stations	30,000
Total	2,690,000

With the fall twice divided at equal distances the cost is found to be slightly more than in the case that has just been considered. The figures are:

	Francs
Conduit	2,010,000
Three central-station buildings	150,000
Equipment of first two stations	400,000
Equipment of third station	100,000
Transmission lines	40,000
Total	2,700,000

Here the second plan, with two falls and stations, is the most economical. However, the author does not forget that a saving in the initial cost of installation may be more than counterbalanced by greater cost of operation and by loss of energy in transmission.—*Revue Générale de l'Electricité*, Jan. 5, 1918 (abstracted from *L'Ettrotecnica*, July 25, 1917).

Telegraphy, Telephony and Signals

Comparative Experiments on the Audion.—G. VALLAURI.—The author gives an account of experiments made with five samples of the audion, with the object of determining their relative behavior as amplifier, generator and detector for the purposes of radiotelegraphy.—London *Electrician*, Feb. 1, 1918.

Miscellaneous

Gas-Engine Troubles and Remedies.—A. L. BRENNAN, JR.—Although during the last few years internal-combustion engines have reached a high degree of perfection, they are still subject to many of their former troubles. How these troubles may be quickly and intelligently diagnosed is told in this article.—*Power*, Jan. 29, 1918.

Buying an Ash-Handling System.—HERBERT E. BIRCH.—How to purchase intelligently an ash-handling system to remove ashes from boiler ash pits is a question that is confronting many engineers and is discussed in this article. It is a timely subject, and the author brings out many ways of solving this apparently simple problem.—*Power*, Feb. 5, 1918.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

NOTE ISSUES APPROVED FOR ELECTRIC UTILITIES

Capital Issues Committee of Federal Reserve Board Acts for Philadelphia Electric Company and in Another Case

The capital issues committee of the Federal Reserve Board has acted favorably upon proposed security issues of electric utilities, holding that the improvements are essential to the conduct of the war.

One issue is that of $7,500,000 Philadelphia Electric Company two-year 6 per cent gold notes, dated Feb. 1. These will be secured upon the property of the subsidiary Delaware County Electric Company, including its large new Chester power station. They were offered for public subscription at 97¾ and interest, yielding about 7¼ per cent, by Harris, Forbes & Company, Drexel & Company and Brown Brothers & Company.

The letter approving this issue, dated Feb. 12 and signed by Paul M. Warburg, chairman capital issues committee, is addressed to the Philadelphia Electric Company and reads:

Referring to the proposed issue of $7,500,000 two-year 6 per cent gold notes of the Philadelphia Electric Company: After inquiring into the purpose of the issue above described we are of opinion that the sale of said notes is not incompatible with the interest of the United States.

This finding constitutes no approval of such issue as regards its merits, security or legality in any respect.

In any public offer or advertisement of the said issue this letter must be incorporated in full.

Similar approval was given in a letter to Charles A. Hinsch, president Fifth-Third National Bank, Cincinnati, regarding an issue of $1,560,900 of two-year 6 per cent first-mortgage lien gold notes of the Union Light, Heat & Power Company, Covington, Ky. These notes were offered at 96¾ and interest, yielding 7¾ per cent, by A. B. Leach & Company, the Fifth-Third National Bank of Cincinnati and Field, Richards & Company.

A statement issued by the capital issues committee says:

The chairman of the capital issues committee, when seen to-day and asked to make some statement concerning the activities of this committee, said that the support which the committee had received from all parts of the country was most encouraging. He cited as an illustration a resolution voluntarily adopted by the governing committee of the New York Stock Exchange, reading as follows:

"Whereas, the Federal Reserve Board has, upon the request of W. G. McAdoo, Secretary of the Treasury, appointed a committee of its members to act as a capital issues committee authorized to pass upon such proposals as may be submitted to them in respect to capital expenditures or issues of new securities,

"Resolved, that the committee on stock list will require, as a condition to the listing of such new capital issues, the presentation of the approval of such committee of the Federal Reserve Board."

Co-operative resolutions have also been passed on the part of municipalities. A case in point is the League of Kansas Municipalities, which, among other recommendations, resolved that:

"It is recommended that during the period of the war each and every city government in this State shall undertake only such paving and other improvement work as may be actually necessary to be undertaken at this time, thereby releasing men and money for the service of the national government."

Another illustration of this spirit of co-operation was cited by him in the resolution adopted by the Richmond Real Estate Exchange, Richmond, Va., as follows:

"Resolved by the Richmond (Va.) Real Estate Exchange that the President of the United States and the Secretary of the Treasury be, and they are hereby, requested to issue an appeal promptly to all governors, and through them to state legislatures, mayors and legislative bodies of municipalities, requesting them to exercise the most careful scrutiny over all appropriations, and to exclude from their respective budgets every item that does not represent an actual necessity for the proper conduct of the government, to the end that the states and municipalities may set an example in patriotism and sacrifice for the institutions and individuals within their respective jurisdictions, and that material and labor may be conserved for the needs of the national government."

In dealing with applications so far submitted, the committee has adopted the policy that whenever the application involves the renewal of maturing obligations such renewal should be favorably considered unless there are particular reasons to the contrary. A similar policy is being adopted by the committee in dealing with the funding of banking debt incurred prior to Feb. 1, 1918.

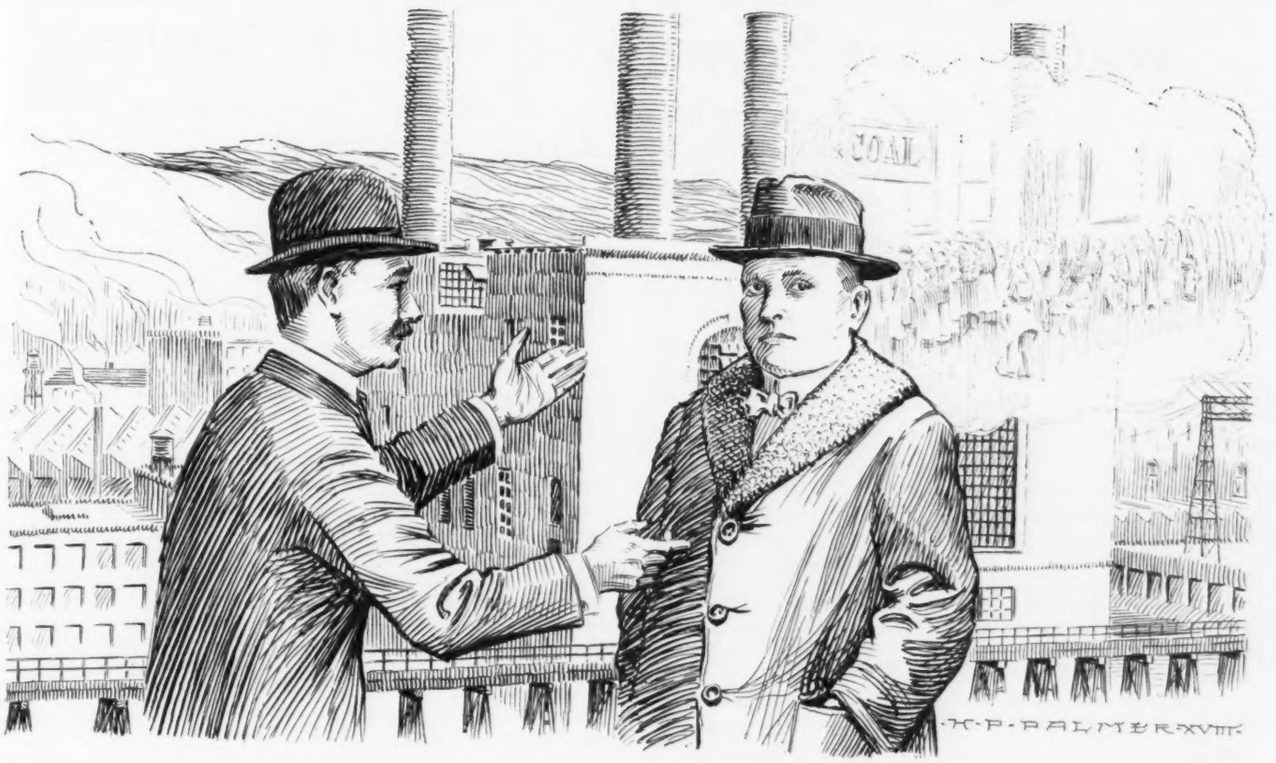
In dealing with bonds to be issued for the purpose of new road construction, the committee has been moved primarily by the consideration of whether or not these roads are of importance either from a military or economic point of view and whether or not results, through the new construction, may be expected to be obtained approximately within the present year.

In passing favorably upon certain projects involving the production of electric power, the committee was guided by the fact that the amount involved was small as compared with the funds already hazarded in such undertakings and by the fact that the power to be produced was required primarily for purposes connected directly with the successful prosecution of the war.

In dealing with municipal and state issues the decisive factor in the deliberations of the committee has been whether or not the expenditure is absolutely necessary for the health and welfare of the community. The committee urges that public authorities, both state and municipal, approve appropriations only where urgently required by the health and welfare of the people.

The advisory committee of the capital issues committee has been in close touch with all local committees established by the twelve Federal Reserve banks, and all personal presentations of applications are being made to them.

On Feb. 8 it held a public hearing at which there appeared representatives of the national organizations of the public utility companies of the country. These representatives discussed with the committee some of the problems and difficulties, both as to operation and finance, under which they were operating due to war conditions. They all pledged their hearty support and co-operation to the purposes to be accomplished by the capital issues committee and assured the committee that during the period of the war capital expenditures would be limited strictly to the most imperative needs. The committee is consulting freely with representatives of the various departments and boards and its work has been facilitated by their advice.



"PLEASE FORGET ABOUT WORKLESS DAYS, DR. GARFIELD. GIVE YOUR UNDIVIDED ATTENTION TO COAL PRODUCTION AND TRANSPORTATION. THAT WILL SOLVE YOUR PROBLEM AND OURS."

TRADE TOPICS DISCUSSED BY CENTRAL DIVISION JOBBERS

War Conservation, Freight Embargoes, Returned Goods, Universal Catalog and Heating Appliance Situation on Chicago Program

At the central division meeting of the Electrical Supply Jobbers' Association in Chicago on Feb. 13 the program consisted mainly of discussion on trade topics and the election of officers.

W. S. Bissell of Toledo, A. C. Downing of Des Moines, Iowa, and James Richardson of Minneapolis each presented a short paper on war conservation and freight embargoes. These papers evoked considerable discussion which brought out the point that jobbers are endeavoring to get along with fewer men. When men are lost from their organizations they advance men already at hand and fill in with men lower in the ranks.

The difficulty experienced in getting shipments due to rail embargoes has been general.

The returned goods evil was discussed informally, and it seemed to be the impression that this troublesome feature of the jobbing business is increasing in extent. Some companies are making a 10 per cent service charge on returned goods, but even this is not an entirely successful expedient since the charge does not nearly cover the entire expense.

As a result of the discussion of a universal electric supply catalog it was decided that Chairman Bernardin should appoint a committee to take up this matter.

The problem of the salesman and his automobile also came up for discussion, and there seemed to be dissent from the opinion that a salesman with an automobile could call upon more customers and solicit business from smaller trade than a man trying to make a territory on foot. There was considerable discussion and difference of opinion as to the way of arriving at the proper method of compensating the salesman for the use of a car in the company's business.

George E. Hughes, president of the Edison Electric Appliance Company, addressed the jobbers on the heating appliance situation. He also spoke at some length on the policy which the Edison Electric Appliance Company will probably pursue in connection with the jobbing trade.

F. M. Bernardin of the B.-R. Electric Company, Kansas City, was re-elected chairman of the division.

ILLINOIS COMMISSION HAS 500 RATE INCREASE CASES

Approximately That Number Filed in January—Questions Developed Concerning Property Value to Expedite Handling Without Serious Delay

Approximately 500 rate cases, in most of which increases are sought, were filed before the Illinois Public Utilities Commission in January.

This large influx of cases, with its demand upon the commission's time, has led to the development of a method of handling rate increase cases which it is believed will facilitate action on many. The commission engineering department has worked up questions dealing with plant property which cover about thirty-five typewritten pages. These can be answered by any practical utility man and do not necessitate detailed valuation.

From the questions it is possible for the commission engineering staff to get a good rough idea of value in much less time than through the older methods. Companies applying for these questions have been supplied by the commission.

War Lessons Shown in A. I. E. E. Sessions

President Rice, at Midwinter Convention in New York, Draws Attention to the Part of the Electrical Engineer in Carrying the War Through to Victory

MORE than the usual amount of interest displayed in connection with convention papers was shown at the midwinter convention of the American Institute of Electrical Engineers, held in New York Feb. 15 and 16, as evidenced by the attendance of more than 400 and the lively discussions provoked. In favorable contrast with some meetings where most of the time is devoted to presentation of papers and little or no time left for discussions, at this convention there was time for these. Furthermore, each speaker was limited to about five minutes' talk, so many suggestive ideas were presented. On account of war conditions, the convention was made a purely business affair, sessions being held on Friday morning, afternoon and evening and Saturday morning.

Summary of the Proceedings

The first session was opened by a presidential address by E. W. Rice, Jr., who discussed the great importance of water-power development and railroad electrification as fuel conservation measures. Following this, a paper was presented upon the selection and rating of oil circuit breakers. Substitutes for primary standard cells, the suitability of the thermal-storage type of demand meters for determining consumers' primary charge and the measurement of dielectric losses in three-conductor cables were the general subjects discussed at the afternoon session, each interesting its own particular field considerably.

Between the afternoon and evening sessions a strictly informal dinner was served at the Café Boulevard, at which Mr. Rice spoke on the necessity for co-operation to win the war. About 225 persons attended. Following the dinner a semi-popular lecture was presented by Dr. A. C. Crehore on "Some Applications of Electromagnetic Theory to Matter."

The Saturday morning session was devoted to discussion regarding alternating-current commutator motors. This subject drifted into that of electrification of railroads, some interesting views being presented on the adaptability of different types of alternating-current motors to this service. Considerable interest was shown in a kinematic device developed by Prof. V. Karapetoff for predetermining the performance of series-wound polyphase motors.

Abstracts of most of the papers and discussions are given in this issue on pages 410 to 413, inclusive.

In his address at the opening of the first session E. W. Rice, Jr., president of the Institute and president General Electric Company, followed the lines of his remarks on the same subjects before the Lynn Section on Feb. 2, which were reported in the Electrical World of Feb. 9, 1918, page 322.

"Members of the electrical profession and industry have reason to be pleased with the contributions which they have made for the benefit of the world," said Mr. Rice in introducing his subject. "While we are glad to think that our science and our industry are fundamentally devoted to the products and conditions of peace, we realize that in the electric light, searchlights, the X-ray, telephones, telegraph, wireless apparatus, electric motors, etc., electricity plays an important part in the grim business of war."

Mr. Rice showed the importance of electricity in coal mining and the effect of railroad electrification in increasing the capacity of trackage and speeding train schedules. He added:

It is estimated that something like 150,000,000 tons of coal was consumed by the railroads in the year 1917. Now we know from the results obtained from such electrical operation of railroads as we already have in this country that it would be possible to save at least two-thirds of this coal if electric locomotives were substituted for the present steam locomotives. On this basis there would be a saving of over 100,000,000 tons of coal in one year.

This is an amount three times as large as the total coal exported from the United States during 1917.

The carrying capacity of our steam roads is also seriously restricted by the movement of coal required for haulage of the trains themselves. It is estimated that fully 10 per cent of the total ton mileage movement behind the engine drawbar is made up of company coal and coal cars, including in this connection the steam-engine tender and its contents. In other words, the useful or revenue-carrying capacity of our steam roads could be increased about 10 per cent with existing track facilities by eliminating the entire company coal movement.

I have not mentioned the consumption of oil by the railroads, which we are told amounted in 1915 to something like 40,000,000 barrels, nearly 15 per cent of the total oil produced. This fuel is entirely too valuable to be used in a wasteful manner. It is important for many reasons that such a wonderful fuel as oil should be most economically used, if for no other reason than that it will be needed for the ships of our forthcoming merchant marine, for the tractors that till our fields and the motor trucks that serve as feeders to our railways.

It should give us courage and optimism for the future of our profession to contemplate the service which we may render in this direction and which it seems to me is immediately at hand. It should arouse in all of us, and particularly in the younger engineers, an enthusiastic confidence in the present and future stability and value of our profession and of the electrical industry. It should satisfy the young engineer that the opportunity for him to render important service is as real and great to-day as it has been in the past for those of us who have seen and participated in the marvelous growth of the industry up to the present.

President Rice's Address at Informal Dinner

At the informal dinner at the Café Boulevard, Broadway and Forty-first Street, on the evening of Feb. 15, Mr. Rice spoke on war conditions and the need for the largest measure of generous co-operation to win the war. His call for "war to victory" met hearty applause.

"There was never a time in the history of the world when work was more needed and when talking is only justified which may help forward the great work which is at hand," were his first words. "We all know what that great job is—the winning of the war. Everything else must wait and take a back seat until that job is done."

Mr. Rice added that we are fortunate in having in our President a spokesman who is able to state the ideals of

the American people and their purpose in this great war in a manner so clear and so impressive as to perfectly satisfy and thrill every loyal American, and he has so appealed to our Allies that he is now accepted as the leading spokesman for all on our side of the war. It is fortunate for the world's future that his messages contain no indication that we will be satisfied with an inconclusive peace, and no matter how much we may hope that his messages may eventually break down the resistance of our enemy, through an appeal to reason, we are warned, said Mr. Rice, that it is vitally necessary to throw our full strength into winning the war, through the exertion of superior military and naval and industrial power. He continued:

The average citizen is mystified and wonders just what is the matter. He was told that the greatest possible production, especially of war material, was vital to our success, and this appealed to his common sense; but just as our manufacturers were getting up speed and working at high pressure they have been ordered to stop and to reduce pressure, as production is said to be ahead of the distributive facilities of the country. He has been told that the army organization has completely broken down. He has seen reports that the submarine menace has been mastered, only to note that the sinkings continue at an alarming rate. He was told that millions of tons of shipping were needed, and an organization was started to build these ships. He saw months of time wasted in talk at a time when every day lost meant the loss of millions of dollars and of thousands of lives. After months of weary waiting the deadlock was broken and we got fairly launched upon a shipping program. We thought that we were running along fairly well when suddenly the entire country was stunned by the recent drastic order of the Fuel Administrator, closing many industries and stopping much of business life.

WHERE PATRIOTISM HAS SCORED

The speaker reviewed the patriotic support of the administration by Congress in the early months of the war, without distinction of party; the Liberty Loans and the patriotic part of "wicked Wall Street"; the drastic scheme of taxation, which will be loyally supported even by those most heavily hit; the magnificent acceptance of the draft system and the Red Cross and kindred activities.

"In view of this record of accomplishment and our truly splendid start in the war," asked Mr. Rice, "why has this feeling of nervousness come over the country? Why has Congress suddenly changed its attitude of unquestioning support to one of investigation and criticism? What does it all mean? Is it true that we are making a failure of the job?" He continued:

It seems clear to me that we have not made a failure, and that everything is moving along as well as we had a right to expect under all the circumstances. When we consider that less than a year ago our nation of a hundred million of people, entirely unprepared for war, with institutions and traditions only adapted to the conditions of profound peace, was thrust into this greatest of enterprises, I think we have already accomplished wonders and that we should not be discouraged. Business men, and especially engineers and manufacturers who understand the nature of the equipment required for this conflict, however, must appreciate that our fundamental, and let us hope not fatal, mistake is that we waited until the war was thrust upon us before we started to get ready.

I think that a little reflection will make it clear that the mistakes that we have made since we started in the war, however numerous or avoidable, are in the aggregate negligible compared with the overwhelming mistake of failure to prepare for the war during 1915 and 1916; that precious time has been lost forever and no effort or time, criticism or talk can cancel that mistake and give us back the lost time. We must expend untold billions and we must make superhuman efforts, but we must be patient and realize that inconsiderate haste is likely to result in added friction, lost motion, false starts and a general retardation of our program.

FROM THE BUSINESS MAN AND ENGINEER'S VIEWPOINT

Hesitating to make any suggestions, Mr. Rice said, however, as a business man and engineer, that certain matters seem worthy of consideration. He added:

To be successful the people must believe in the war and must work for the war. It would seem, therefore, that, this fact being recognized, we should not attempt to handle the job on the basis that it is to be run exclusively by the party in power. In such an emergency it does not seem probable that we can get best results by our customary majority or party government. All the people must be represented.

The country is greatly encouraged at the large number of able men, prominent in business and other walks of life, who have volunteered for service in various departments of the government and who have been accepted and set to work. This policy should be encouraged, as the more it is followed the better the country will be satisfied and the sooner we will win the war.

It is essential that the men who are charged with enormous responsibilities in our governmental enterprises have the confidence of the country, as their orders, no matter how drastic or arbitrary or apparently unnecessary, should be followed with confidence. At the present time orders are patriotically obeyed, but with some misgiving, due not so much to the hardships inflicted as to the feeling that our leaders do not fully realize what they are doing. There is no lack of confidence in their good intentions and character, but there is some questioning of their wisdom and practical experience.

I like the President's expression, "spirit of accommodation," for that is an essential element of co-operation.

We must have co-operation between the government and industries, and to be effective this means that both must be parties to the co-operation. It cannot be a "lion and lamb" sort of affair. If the governmental heads use their vast power arbitrarily and unwisely, they can easily cripple the industries of the country and thus delay victory for years.

Take, for example, the matter of priority. This is merely one of the factors of production. All large industrial establishments handle such matters through a production department with a production manager at its head. Such a man is settling questions of priority every day. If he settles them wisely, the industrial organization is successful; if he makes many mistakes, the organization will function badly and probably fail. If an inexperienced man were put in charge of the production of any establishment, he could, and probably would, with the best of intentions, reduce the productive efficiency of such an establishment by 50 per cent within a few weeks.

I believe that the problems facing us will be successfully solved in time, but we need more co-operation, more of the spirit of accommodation, all our patience and wisdom, and above all, a willingness to work to the limit.

We must discipline ourselves until a shirker in any field of useful effort will be regarded with the same contempt as a shirker in the military service of the country.

PHILADELPHIA ELECTRIC RATE INCREASE APPROVED

Advance of 10 per Cent in Power Schedule Authorized by Pennsylvania Public Service Commission Because of Higher Costs

An increase of 10 per cent in rates of power consumers of the Philadelphia Electric Company has been authorized by the Pennsylvania Public Service Commission. The advance in rates was approved by the commission on account of the higher expense of operation.

MUCH DISCUSSION ON THE CURTAILMENT OF LIGHTING

Many Viewpoints Developed Before Illuminating Engineering Society After Presentation of Preston S. Millar's Paper

A greatly interested audience gathered at the special meeting of the Illuminating Engineering Society in the Engineering Societies Building, New York, on the evening of Feb. 14, at which a paper on "Lighting Curtailment" was presented by Preston S. Millar, general manager Electrical Testing Laboratories, New York. Extracts from this paper were published in the ELECTRICAL WORLD of Feb. 16, 1918, page 370.

President G. H. Stickney in opening the meeting said that there are a great many things in the pursuit of happiness that were commendable a year ago which to-day must either be restricted or eliminated in order that we may carry this war through to victory. Waste of lighting must be prevented. On the other hand, light is a very important adjunct in the war from the battle line back through the lines of transportation, through manufacture, through all the activities of life, and there are some places where lighting may need to be increased. The society has been very fortunate in having opportunities to serve the country in the emergency, said Mr. Stickney.

MR. LIEB ON PRESENT-DAY PROBLEMS

Following Mr. Millar's presentation of his paper, the discussion was opened by J. W. Lieb, chairman National Committee on Gas and Electric Service. Mr. Lieb expressed the appreciation of the National Committee for the effective co-operation rendered by the Illuminating Engineering Society and the readiness and enthusiasm with which the members of its war service committee had responded to the repeated calls made by various government departments through the national committee and passed on to the society. He described the attitude which the national committee, acting on behalf of the gas and electric utilities, has taken in cooperating with the authorities in restricting unnecessary use of energy.

Mr. Lieb added that he would not endeavor to discuss the wisdom or the expediency of avoiding, as has been done, the classification of industries into essential and non-essential or dispensable and indispensable. He declared, however, that if any one wished to obtain for himself some idea of the difficulties involved in such a preparation of order of priority, say, of industries, he might make out what he would think was a proper order of priority or of dispensability of industries, classify it either by classes of business or industries, and he would find out very soon the enormous difficulties which such a classification presents. The fundamental touchstone is, "Is this or that industry immediately contributory to the conduct of the war?" Following that must of necessity be the consideration, "Is this or that industry indispensable to the public health and public welfare?" From these two fundamentals one would branch out and go down the list through industries of varying importance. The difficulties in making such a differentiation are enormous and they really do not impress themselves until one undertakes to make for himself such a differentiation, Mr. Lieb said.

In giving estimates as to the effect of lighting curtailment Mr. Lieb said that exterior illumination was estimated at one-half of 1 to 1 per cent of the total output. It is not easy to find a difference in coal consumption of one-half of 1 to 1 per cent, but when it is coupled with the proposition that selected coal is impossible to obtain and when there is a variation in coal consumption from day to day of 10 or 15 per cent, the problem has added difficulties.

The experience of most of the prominent lighting companies in the five day suspension period was that roughly the output of power houses was curtailed on the average about 25 per cent, said Mr. Lieb. On the closed Mondays there was a reduction of approximately 35 per cent.

Dr. Coleman W. Cutler, chairman illumination committee, National Committee for the Prevention of Blindness, said that the saving of light may be of value in the saving of energy. The most of what the increased flood of lighting has given to the world is very beneficial, but some people cannot keep up with the demands of highly stimulated conditions. Children and working classes suffer most from insufficient lighting, and curtailment of their supply would be little short of criminal.

Dr. M. G. Lloyd, Bureau of Standards, expressed thorough sympathy with the general attitude of the author of the paper. He said that he would like to see the Fuel Administration conduct a campaign along the lines of the Food Administration, bringing home to every power plant operator and to every residence dweller who operates a furnace the necessity for making the best use of fuel. Dr. Lloyd referred to the estimate in the recent paper of Lynn S. Goodman and William B. Jackson before the American Institute of Electrical Engineers [see ELECTRICAL WORLD, Jan. 19, 1918.—Eds.] that the increased coal consumption due to poor quality is 10 per cent. If that could be eliminated there would be, on the figures given in the paper, a saving of 64,000,000 tons, which would more than cover the estimated shortage, and then the little saving effected by cutting down on lighting would be unnecessary.

Frank W. Smith, chairman lamp committee, National Electric Light Association, and vice-president United Electric Light & Power Company, New York, spoke of the action of New York electric and gas companies in circulating 1,800,000 fuel conservation cards among their consumers. He said that of the 145,000,000 lamps sold in the United States in 1916 more than 16 per cent were of the carbon and gem types. A very material saving in fuel would result from substitution of more efficient lamps.

DR. BELL ON THE FUEL ADMINISTRATION

Dr. Louis Bell, Boston, said that central stations would do their part manfully and would see that the use of light is economized so far as the saving does not interfere with the country's efficiency. He urged, however, that the Fuel Administration cut out unnecessary industries with a ruthless hand. The Fuel Administration could drive hard at the wastes which are unnecessary and inexcusable in business that has nothing to do with the great end of the war. The Fuel Administration before turning to central stations to curtail output or simultaneously with that demand (for these properties are willing to take their medicine with the rest) should suppress unnecessary industries.

Bassett Jones, New York, brought out the importance of a campaign to economize fuel in the home, similar to the Food Administration campaign.

W. A. Durgin, Commonwealth Edison Company, Chicago, discussed the necessity for developing efficiency in household fuel consumption and also the importance of saving eyesight as factors that should have careful consideration.

W. D'A. Ryan, General Electric Company, said that lighting is not anywhere near as large in volume as it should be. In place of an increase of 73 per cent there should be from 100 per cent to 200 per cent increase.

After the successful conclusion of the war, street lighting and industrial lighting should be increased an average of 150 per cent. In his work of illumination in Western cities Mr. Ryan is increasing the light, not 100 or 200 per cent, but from 500 to 1000 per cent. Recently the white way lighting in an Eastern city was turned out. This is protective lighting, and after three nights, on account of the increase of crime and nuisances, it was found necessary to restore the illumination.

Norman Macbeth, New York, said that newspapers had made a tremendous fuss about electric advertising. This is a form of advertising that has justified itself; it reduces sales cost.

MR. DOANE ON GROWTH OF LIGHTING BUSINESS

S. E. Doane, National Lamp Works of General Electric Company, said that the lighting business of the country has increased more rapidly than ever before. In spite of the effort to economize in lighting, the building of shipyards, operation of factories at night, construction of cantonments and many other things have tended to increase the use. Mr. Doane said he did not see how the industries could be served better than by making the fact clear that the solution of the problem does not lie in conserving lighting. We can look forward to no saving of coal, but on the contrary to a greater use of coal for lighting than ever before. Emphasizing the need of economy in lighting and in fuel in the home, Mr. Doane urged that the services of patriotic women should be enlisted.

W. J. Serrill, Philadelphia, thought that the chances were that the transportation system would be improved so much next winter that such a crisis would not occur again and that there ought not to be any reduction in lighting. Mr. Serrill expressed the opinion that a great deal of the present white way lighting is an extreme vulgarity and an advertising defacement of the cities. Considering what the illuminating engineer has done in flood lighting, what beautiful effects can be shown on the handsome facades of buildings, Mr. Serrill thinks that it is a pity to push too far the present type of moving sign lighting.

Mr. Jones spoke of the question of painting for light. He will report at a later meeting of the society the case of a factory in which the painting for light was so worked out that repeated tests showed utilization of over 100 per cent; in other words, that more light was being received than the lamps furnished. It is remarkable what can be done by treatment of the wall surfaces. Prism glass was also used in the windows of the factory.

R. E. Simpson, engineer Travelers' Insurance Company, Hartford, Conn., said that a director of a company operating twenty or more mills ordered that all unnecessary lighting should be cut down. One foreman cut out the lighting of stairways and other unfrequented places. The result was unprecedented increase in the accident rate, particularly at the points where lights were taken away. This was brought to a climax when one man was caught by a shaft near the ground and killed.

Among others who contributed to the discusstion were A. L. Powell, Frank E. Wallis, W. H. Rolinson and W. J. Hammer. Mr. Millar also spoke in closing the discussion.

WITH EXCESS POWER SUPPLY, LOUISVILLE SEEKS INDUSTRIES

Margin in Capacity Above Current Demands of Customers Used to Boost Campaign for New Industrial Establishments

Donald McDonald, vice-president and general manager of the Louisville Gas & Electric Company, has been named vice-president of the Louisville Industrial Foundation, the million-dollar industrial department of the Louisville Board of Trade, which public subscription

10,000 K.W.
Surplus
Electric Power
In Louisville, Ky.,
for Manufacturing
The Louisville Central Power Station has at this time more than 10,000 K. W. surplus electric power for industrial purposes, immediately available.
Louisville can supply a considerable area of floor space for manufacturing purposes.
Modern dwellings for workmen are available in Louisville at moderate rentals.
Louisville is one of the few cities of the United States favored with surplus electric power for industries in excess of present demands.
The Central Power Station owns its coal mine and operates its own coal cars, assuring a plentiful supply of fuel and continuity of surplus electric power.
Surplus electric power, together with industrial floor space and comfortable homes for workmen, affords manufacturers a remarkable opportunity for additional industrial operations at this time.
For detailed information and power rates, write or wire
TAMPTON AUBUCHON, General Manager
Louisville Industrial Foundation
Incorporated
CAPITAL $1,100,000.00
910 Columbia Building
Louisville, Kentucky

HOW THE LOUISVILLE BOARD OF TRADE IS ADVERTISING THE OPPORTUNITIES OFFERED INDUSTRIAL ENTERPRISES BY THE KENTUCKY CITY

has supported for the purpose of attracting new industries to the city. This department has already been of considerable benefit to the Louisville Gas & Electric Company, as the foundation, offering financial aid in some cases, has been instrumental in getting a number of small industries using central-station service to locate in Louisville.

The accompanying advertisement from the New York *Times* shows what Louisville is doing.

WAR SERVICE WORK OF THE UTILITIES COMMITTEE

Returns to Fuel Administrator on Five Workless Days and Three Mondays Show Perhaps 30 per Cent Saving in Fuel

A report of recent activities of the National Committee on Gas and Electric Service, of which J. W. Lieb is chairman, has been received by the ELECTRICAL WORLD. It says that with improvement in weather conditions the reports received from public utilities give reason to believe that transportation facilities have ameliorated considerably and that both coal and oil shipments are moving with more freedom. At the request of the Fuel Administration the public utilities secured information as to the relative saving in output and coal supply for the five-day period and three Mondays following. The returns showed about 21 per cent reduction in output and a coal saving of perhaps 30 per cent.

The report of the committee says in part:

The Fuel Administration through M. L. Requa, Oil Administrator, has issued an order of preference for oil shipments. Public utilities are placed in the fifth class, thus insuring them a continuous supply of fuel and gas oil. The preferential order is divided into twelve groups, and it is estimated that the first ten groups will use but 60 per cent of the oil produced. From this it is quite evident that there will be an ample supply to care for the wants of the public utilities.

The Director General of Railroads has also issued instructions that both coal and oil are exempted from all embargo restrictions, thus giving free movement forward of these commodities which are an essential part of the supply of every public utility.

The priorities committee of the Council of National Defense has recently issued a new form of application for priority, to which is attached a form for the applicant making an affidavit that the conditions are as represented in the application. These forms of priority are used particularly for the procuring of material which is very essential to plants that are furnishing electrical energy to munitions manufacturers in general.

Surveys are still being conducted throughout the country in order to obtain accurate information as to the conditions of electric power supply for manufacturing purposes. It has also become necessary to make an investigation of the gas companies on which demands are being made for the industrial use of gas, which much exceeds the capacity of some of the gas companies. It is very much to be desired that public utilities notify this committee of any excess available power that may exist in their communities which would attract war material manufacturers to their vicinity.

The committee has been requested by the Quartermaster's Department to find in the public utility field, if possible, 200 or 250 competent auditors. It is extremely difficult to get information on this class of work, and the public utilities are probably in the same position as other industries in having very few such men available.

"Terminal pools" have been formed in about half a dozen large centers in the Middle West, and these pools are working quite satisfactorily in improving the delivery of coal to public utilities.

A zoning system of coal production areas which will supply coal to zones of consumption in order to avoid cross haulage is being considered and worked out by the Fuel Administration, but no orders on this have yet been issued. It has, however, been definitely decided to make no effort for the present toward arranging for zones of gas coal.

Senator Ramsdell of Louisiana headed a delegation which called on the committee in Washington with reference to procuring assistance in the developing of natural gas wells in Louisiana for the purpose of furnishing service to war industry plants, such as the proposed chemical plants which are being constructed by the government. Arrangements were made to bring his proposition before the proper authorities.

The commission on car service has recently issued Circular No. 84 containing instructions to all the carriers that in confiscating coal no coal must be taken that is consigned to public utilities. The gas and electric companies will feel considerably relieved when these instructions are carried out, as the taking of coal by the railroads has seriously interfered with the operations of public utilities.

The committee is also working with the conservation department of the Fuel Administration Bureau on several plans to conserve the consumption of coal, and will shortly seek information from the various public utilities in order to arrive at conclusions as to the best way to proceed.

Information is being received by the committee from the various public utilities requested to furnish information to be presented to Dr. Garfield showing the percentage of output of either electric energy or gas to be used by manufacturers turning out war materials. Some of these reports indicate an amazingly high percentage of output furnished for this purpose.

The War Department has recently asked the committee to obtain information as to the possibility of taking over 200,000 kw. in turbine units which have been ordered by central stations from the large electrical manufacturing companies. This does not necessarily mean that the turbines will be commandeered, but a survey of these conditions has been thought necessary by the department, and the committee is being used as the avenue for procuring this information.

The committee has been called upon to furnish the names of several young men who have had experience along operating lines with central stations and power plants to enter the government service with commissions. It is the intention to place these men in the service of the War Department and assign them to make a survey of electrical conditions throughout the country and expedite matters in connection with power service to war industry manufacturers.

INDUSTRIAL PEACE CONFEREES NAMED

Secretary of Labor Wilson Announces Personnel of Joint Conference of Employers and Union Labor Leaders

Secretary of Labor Wilson has announced the personnel of the joint conference of employers and union labor leaders who will lay down a basis of relations between capital and labor during the war. Five members, as follows, were chosen to represent each side by the National Industrial Conference Board and American Federation of Labor and they will select two additional representatives of the public.

Representatives of employers: Loyal A. Osborne, New York, vice-president Westinghouse Electric & Manufacturing Company and chairman executive committee National Industrial Conference Board; Charles F. Brooker, Ansonia, Conn., president American Brass Company; W. J. Vandervoort, East Moline, Ill., president Root & Vandervoort Engineering Company; L. F. Loree, New York, president Delaware & Hudson Company; C. Edwin Michael, Roanoke, Va., president Virginia Bridge & Iron Company.

Representatives of workers: Frank J. Hayes, president United Mine Workers of America, Indianapolis; William L. Hutcheson, president United Brotherhood of Carpenters and Joiners of America, Indianapolis; J. A. Franklin, president Brotherhood of Boilermakers and Iron Shipbuilders of America, Kansas City, Kan.; Victor Olander, representative International Seamen's Union of America, Chicago; T. A. Rickert, president United Garment Workers of America, Chicago.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Philadelphia Section, I. E. S.—Preston S. Millar addressed the Philadelphia Section of the Illuminating Engineering Society on Feb. 15 on the subject of "Lighting Curtailment."

Chicago Section, A. I. E. E.—Thaddeus Baily and John A. Seede will address the Chicago Section of the American Institute of Electrical Engineers on Feb. 25 on "Electric Furnaces."

Schenectady Section, A. I. E. E.—P. W. Wilson, special correspondent for the London *Daily News*, addressed a meeting of the Schenectady Section of the American Institute of Electrical Engineers on Feb. 20 on the subject of "Britain at War."

Engineers' Society of Milwaukee.—E. S. H. Baars of the Vilter Manufacturing Company gave an illustrated talk on "Coal Accumulators and Their Application to the Refrigerating Industry" at a meeting of the Engineers' Society of Milwaukee on Feb. 13. Alexander H. Luedicke and Fred Goes of the same company gave an illustrated talk on army refrigerating equipments.

Association of Iron and Steel Electrical Engineers.—The next regular meeting of the Philadelphia Section will be held on March 1. John S. Rowan of the Rowan Controller Company of Baltimore will present a paper on "Standardized Mill Table Controllers." B. W. Gilson of the Carnegie Steel Company, Youngstown, Ohio, will deliver a paper on "Generation, Distribution and Consumption of Power" at the regular meeting of the Cleveland District Section to be held Feb. 23. A joint technical session of the A. I. E. E. and the Cleveland District Section of the A. I. and S. E. E. will be held March 18. The Pittsburgh Section will meet March 16.

Prominent Engineers Attend Dedication of Dayton Engineers' Club.—The following attended the ceremonies in connection with dedication of the new Engineers' Club at Dayton, Ohio: Dr. W. O. Thompson, Gordon Rentschler of Hamilton, Elmer A. Sperry, Sr.; Elmer Sperry, Jr., and F. M. Tait of New York, Lieut. F. Vezzani, Col. J. J. Carty, Gov. James M. Cox, Major J. G. Vincent, H. M. Allen of Troy, Dr. L. H. Baekeland, Dr. Clark W. Chamberlain, Major C. M. Hall, W. B. Mayo and F. P. Book of Detroit, Commander McCormick, U. S. N.; J. H. Libberton of Chicago; C. E. Drayer, Cleveland Engineers' Club; A. M. Wilson, Cincinnati Engineers' Club; F. W. Weissmann, American Chemical Society, Cincinnati; Walter S. Wing, Society of Engineers of Western Pennsylvania; Col. E. A. Deeds, C. F. Kettering and Major Orville Wright.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Accounting in Illinois.—The accounting department of the Illinois Public Utilities Commission has prepared standard accounts for gas, electric, water and heating companies, effective on Jan. 1, 1918.

Surcharge Authorized in Noblesville, Ind.—The Indiana Public Service Commission has entered an order authorizing the Noblesville Heat, Light & Power Company to add a surcharge, as a war-time emergency measure, of ½ cent for each kilowatt of energy furnished. The order extends to Feb. 1, 1919. The commission estimates that a surcharge will bring the company about $2,500 additional revenue during the coming year. Increased cost of operation, including the tremendous increase in price of coal, made addition to the revenues necessary.

Overtaxation.—A decision of the New York Public Service Commission, First District, written by Commissioner Travis H. Whitney, places responsibility for the poor condition of many surface railroads upon the burden of overtaxation placed on them by city and State. Denying the application of the North Shore Traction Company for authority to increase the fare from 5 to 7 cents, the decision says: "The responsibility of the city and State authorities for inadequacies of the corporate income of companies such as this petitioner is thus strikingly manifested. If the city and State wish to require passengers to pay high enough fares to enable the street-railroad companies to pay into the public treasury not only real estate, local and school taxes but also franchise taxes, percentages on gross earnings and the like, and in addition wish the passengers within a comparatively short period to buy for the city and pay for property which the city says must pass soon to city ownership without further payment therefor, the bearings of such a policy should be frankly recognized. What goes into the public treasury must under such circumstances come out of the fare payer or must in some other form come out of the taxpayer. It cannot, over any long period of time, come out of the investors. Efforts to leave the investors to bear the burden can only mean deterioration of service, failure to make needed extensions and eventual receivership. Ought the city to require passengers to pay the cost of early city ownership of all the company's property situated in the city streets and nevertheless leave the company's property unable to do more than furnish to those passengers grossly inferior service?"

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Exercise of Care in Stringing Power Wires Across Telephone Wires. — It is the duty of an electric company in the construction and maintenance of its wires carrying heavy currents of electricity across the space where telephone or other such wires are strung to make approved and effective provision against the communication of its current to such telephone or other wires, it was held by the Supreme Court of Appeals of West Virginia (94 S. E. 372).

Duty to Repair Wires.—While a telephone company is bound to exercise ordinary care to keep its poles, wires and appurtenances in such condition as will make their presence along a highway reasonably safe for persons traveling thereon, it is not liable for injuries occasioned by a break because of an unknown defect occurring after nightfall, which was repaired the following morning as soon as discovered, the Court of Appeals of Kentucky held (198 S. W. 721).

No Liability When Adequately Forewarned. — Where an employee of the city water commissioners who was killed while patching gutters on a pumping station by contact with wires supplying the electric power to the station was warned not to get near the wires and told after finishing one gutter to move his ladder around to another and thus avoid the wires, and where if he had heeded such instructions he would not have been injured, there could be no recovery for his death from the employer or the power company, the Supreme Court of North Carolina held (94 S. E. 299).

Negligence in Case of Broken Wire. —Unexplained, the fact that the feed cable of an electric street railroad had broken away from its fastening to an iron pole at the street side and at intervals came in contact with the pole, as a consequence of which a boy received a shock, created a presumption of negligence, under the doctrine of *res ipsa loquitur* (the thing speaks for itself), the Supreme Court of New York, Appellate Division, held (167 N. Y. S. 690). The presumption of negligence from the fact of a feed cable of a street railroad having broken loose from its fastening to an iron pole at the side of the street, and so having come in contact with it occasionally, thus shocking a boy, is not overcome by showing that this was caused by lightning in the forenoon, eight hours before, in the absence of convincing evidence that the company exercised all reasonable care to discover and remove the menace.

Employment of Girls as Meter Readers.—The Binghamton (N. Y.) Light, Heat & Power Company has begun to employ girls to read meters and deliver bills. It has been found advisable to do this on account of the general labor conditions, and it is in line with the policy adopted about six months ago of employing girls in all branches of the work where it is feasible to do so, thereby releasing many men for federal service.

Saving Power in Canada. — The Hydro-Electric Commission of Niagara Falls, Ont., at its annual meeting elected Mayor H. P. Stephens chairman. A communication was read from Sir Henry Drayton, Dominion Power Controller, and the Ontario Hydro-Electric Power Commission asking the city to reduce street lighting. A municipal campaign will be waged urging householders to reduce electric lighting in homes so as to release additional power for Canadian war industries.

Speeding Instruction at Cornell.—Because of the exceptional demand for trained engineers for government war needs, the faculty of Sibley College of Mechanical Engineering, Cornell University, has signified its willingness to carry regular work for the present sophomore and junior classes through the summer as a first term of the junior and senior years respectively, and to continue sixteen-week terms, practically without interruption, until these classes are graduated. This will furnish graduates for government service considerably earlier than would be possible otherwise. This is regarded as a war measure only and will not remain in force at the close of the war.

Terre Haute, Indianapolis & Eastern to Buy Plant.—The Terre Haute, Indianapolis & Eastern Traction Company has petitioned the Indiana Public Service Commission for authority to purchase the common and preferred stock of the West Indiana Utilities Company, which operates lighting plants at West Terre Haute and Brazil, Ind., for $121,000 cash, and for authority thus to eliminate competitive conditions at Brazil. The traction company has sold electricity to the West Indiana Utilities Company plant there and also furnished similar service itself. The common stock of the West Indiana company totals $50,000 and preferred stock $150,000, representing all the capital.

Common Stock Dividend Passed.—Commonwealth Power, Railway & Light Company directors have passed the common stock dividend. A dividend of 1½ per cent was declared on the preferred, payable in scrip due on or before Feb 1, 1924, with 6 per cent interest payable semi-annually. President Anton G. Hodenpyl said: "While the earnings are sufficient to pay the usual dividends, nevertheless because of the present abnormally high cost of operation and the inadvisability if not impossibility of marketing long-time securities, your directors have felt that the company's net earnings should for the present be conserved and used in place of the moneys usually derived from the sale of securities."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Stops Payments to Soldiers and Dependents.—In general it has been decided by the board of directors of the Commonwealth Edison Company that the practice of the company in making payments to the dependents of employees who have entered the military service of the United States should be suspended as of Jan. 1, 1918. It was found that the government plan of allotments, etc., was in effect the same as the company's plan, except that in some cases the amount to be paid by the government was less. It was decided that in certain cases the company might continue to do something for dependents of employees in military service.

Power Development Commission Completes Work.—The Power Development Commission of New York, headed by Senator George F. Thompson of Niagara, has completed its seven years' labors in the investigation of the possibilities of water-power development. The outstanding feature of its report to the Legislature is that it places on record the meaning of the waste of force at Niagara Falls. The commission states that half the flow of Niagara River, if diverted to the purpose, would light and heat all the homes of the State and turn all the wheels of industry, with a saving of the 40,000,000 tons of coal burned last year. Washington officials are to be urged to seek the concurrence of Canada in such changes in the treaty as would permit the use of waters above the Falls for the development of hydro-electric power of ten times the present limit of 400,000 hp.

Inmates of Institution Help to Save Valuable Metals.—The House of Correction, Chicago, under the direction of John L. Whitman, is effecting considerable saving in handling junk material discarded by municipal departments or institutions. Pieces of copper wire discarded by the electrical department are collected and the rubber and lead insulation is removed by hand. Under the commercial system of reduction the rubber would be lost. By employing unskilled labor the superintendent was able to conserve over $11,000 worth of rubber. One inmate was employed in cutting small particles of platinum in electric light bulbs discarded by various public buildings. Working with an old washboard and a druggist's mortar, he conserved over $9,000 worth in less than a year. The lamps were of the older type, since platinum has not been used in constructing the leading-in wires of incandescent lamps for three years. Some lamps dating back more than twenty years contain 10 cents' worth of platinum at present prices.

Sanitary District Raises Salaries.—The Sanitary District of Chicago has raised the salaries of all employees who did not receive salary increases last year. The total raise distributed among 525 employees amounts to $60,000 per year, bringing the total salary payroll of the Sanitary District up to $1,062,000 per annum. A large percentage of the men in the engineering department of the district are affected by this order.

Civilian Workers Needed for Army Ordnance Department.—The Ordnance Department of the army urgently needs several thousand civilian workers. The United States Civil Service Commission is conducting an extensive campaign to obtain this needed help. Workers are desired for different classes of positions, including clerical, testing, mechanical trades, drafting and inspection. They are vitally necessary in the prosecution of the war. They will form part of the forces behind the front without which the actual fighters would be powerless. For further information apply to the representative of the United States Civil Service Commission at the post office or custom house in any city, or to the Civil Service Commission, Washington, D. C. Except for the positions of stenographer and typewriter, typewriter operator, multigraph operator and general clerk, applicants are not assembled for a written examination, but are rated principally upon their education, training and experience, as shown by their applications and corroborative evidence.

Men Wanted for Navy Aviation Service.—The Navy Department announces that men will be selected soon for aviation service. Men of suitable qualifications who report now to the navy recruiting offices are eligible for examination for commissions and ratings. Rates of pay and duties assigned will make this opportunity highly attractive to mechanical engineers and to draftsmen, mechanics and others experienced in gasoline engine design or operation. Men are to be selected to equip for special work in connection with aviation as follows: Experienced engineers for engineer officers at the various naval air stations; experienced gasoline engine men for further instruction at Columbia University and special instruction at Packard Motor Company on Liberty engines; graduate mechanical engineers and men of experience along engineering lines for special duty in Bureau of Steam Engineering and in connection with work of this bureau at various places; aeronautical and other gasoline-engine draftsmen for work in the Bureau of Steam Engineering; men who have had experience in compressed gases, especially hydrogen; mechanical engineers for special work under the Bureau of Construction and Repair; mechanical draftsmen for duty in Bureau of Construction and Repair on aviation work; suitable men for training for quartermasters' (aviation) and carpenters' mates. Full information may be obtained at any navy recruiting office.

J. B. OLSON

Men of the Industry

Changes in Personnel and Position—Biographical Notes

C. R. UNDERHILL

James B. Olson, who has resigned from the Habirshaw Electric Cable Company, Inc., of which he was assistant secretary and general sales manager, as noted in last week's ELECTRICAL WORLD, is one of the best-known wire men in the country. Mr. Olson entered the wire industry in 1888 with the New York Insulated Wire Company. In 1892 he went to Chicago, where for two years he was Western sales manager for that company. On Jan. 1, 1894, he resigned to go with the India Rubber & Gutta Percha Insulation Company, afterward changed to Habirshaw Wire Company, of which he was made general sales manager and afterward secretary. On the consolidation of this company with the Electric Cable Company and the Waterbury Company, two years ago, Mr. Olson became general sales manager of the new company, the present Habirshaw Electric Cable Company. Later he was made an officer of the company under the title of assistant secretary.

Frank E. Watts, New York district manager of the Hart Manufacturing Company, past-Jupiter of the Jovian Order and former Eastern manager of the ELECTRICAL WORLD, is suffering from a broken leg received as the result of a fall on an icy pavement on Wednesday of last week. His right leg is broken about four inches above the ankle.

Prof. D. M. Folsom, head of the School of Mines at Stanford University, California, on Feb. 6 was made petroleum administrator for the Western States by Mark L. Requa, National Oil Administrator. Mr. Folsom has been serving as chairman of the petroleum committee of the State Fuel Administrator in California and is one of the leading oil experts of the West. In his new capacity he will have supervision over the production and distribution of petroleum in the States of California, Washington, Oregon, Idaho, Utah, Nevada and Arizona and the Territories of Alaska and Hawaii. This appointment is taken to mean the abolition of the petroleum committee, which consisted of Professor Folsom and two members of the Railroad Commission of California.

H. G. Bonner, formerly new-business manager of the Alliance (Ohio) Gas & Power Company, has been made manager, succeeding F. C. Pratt. Mr. Bonner entered the Doherty organization five years ago as new-business manager at Elyria, Ohio, having been prior to that manager of the Louisville (Ky.) branch of the Westinghouse Electric & Manufacturing Company.

Samuel Scovil, president of the Cleveland Electric Illuminating Company, has resigned, and is now in the employ of the government as representative of the Cleveland district of the Federal Ordnance Department. Mr. Scovil has been president of the Cleveland company for the past four years, having been vice-president prior to that. Mr. Scovil, who is well known throughout the electrical industry, was elected third vice-president of the National Electric Light Association at its annual meeting last summer.

Frederick W. Prince, superintendent of the lighting department of the Hartford (Conn.) Electric Light Company, has resigned to join the staff of the Franklin Electric Manufacturing Company of Hartford. Mr. Prince is well known in central-station circles, having taken an active part in the work of the New England Section of the N. E. L. A. and been employed by the Hartford company for about eighteen years. He was educated at Trinity College, Hartford, graduating in electrical engineering under Prof. W. L. Robb, for many years consulting engineer of the Hartford company. In his new work, which is scheduled to begin April 1, Mr. Prince will hold the title of quality expert, co-ordinating the work of the engineering, production and sales departments, with headquarters in Hartford.

Charles Reginald Underhill, who has recently been appointed captain in the aviation section of the Signal Reserve Corps, as announced in the Jan. 12 issue of the ELECTRICAL WORLD, was chief electrical engineer of the Acme Wire Company, New Haven, Conn. Mr. Underhill was born in 1874 and received his primary education in the district schools near Buffalo. After a brief career as telegraph operator, he entered the employ of the Western Electric Company, New York City, in the inspection department. During the latter term of this employment, having charge of the inspection department as assistant chief inspector, he became interested in the design of electromagnets and resigned to become chief electrical engineer of the Varley Duplex Magnet Company, and in the next four years, while connected with this company, he made numerous experiments with electromagnets, particularly the solenoid type, the results of which were published in a series of articles in the ELECTRICAL WORLD. In the same period he wrote his book "The Electromagnet." About this time wireless telegraphy was being rapidly developed, and Mr. Underhill invented and demonstrated a wireless printing telegraph system. From 1904 to 1909 he was consulting electrical engineer in New York City, specializing in signal systems and electromagnetic devices. At this time he wrote his book "Solenoids, Electromagnets and Electromagnetic Windings." and in collaboration with W. W. Massie wrote "Wireless Telegraphy and Telephony." For a brief period Mr. Underhill was employed as editor and technical writer for the Westinghouse Electric & Manufacturing Company, from which position he resigned in 1910 to become chief engineer of the American Electric Fuse Company. Since 1911 he has been employed by the Acme Wire Company as chief electrical engineer, during which period he has made extensive researches into the operation of electromagnets. For several years past he has lectured at the leading engineering colleges on the subject of electromagnets and their application. Mr. Underhill is the author of "Electromagnets, Induction Coils and Condensers," Section 5 of the "Standard Handbook for Electrical Engineers." He is a member of a number of national engineering societies, in addition to being a fellow of the American Institute of Electrical Engineers.

Obituary

Prof. Joseph Frederick Klein, dean of the faculty and head of the mechanical engineering department of Lehigh University, died suddenly on Feb. 11. Prof. Klein was born in Paris in 1849 and came to this country when four years old. He attended the Sheffield Scientific School of Yale University, from which he received the degree of Ph.B. in 1871 and the degree of D.E. in 1873. He had been professor of mechanical engineering at Lehigh since 1881.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

CHANGING CONDITIONS IN VACUUM-CLEANER MARKET

Manufacturers Considering More Closely Problems of Distribution in Order to Eliminate Certain Abuses Arising from Ignorant Competition

The general condition in the vacuum-cleaner field is unsatisfactory. This is true not on account of the volume of sales, for manufacturers are at present finding it easy to sell all the machines they can make from the material they can get. It is true, however, on account of the relations obtaining between the manufacturers and the various distributing agencies. On account of the fact that in the past manufacturers have mainly sold vacuum cleaners by going out to agents with a special proposition entailing extensive advertising, campaigns and free services of salesmen, the business has got into a state where the profit to the manufacturer is generally unsatisfactory.

Owing to the present steady demand and the limited supply, the time seems propitious to manufacturers for changing their policies and putting the sweeper on a commodity basis. One large manufacturer is making a serious effort to overcome past mistakes made in direct selling and is organizing to sell through the electrical trade. Another who had become dissatisfied with the electrical trade and who branched out into the hardware and department store field to obtain his agencies is considering coming back into the electrical trade. Efforts are being made to bring more manufacturers to a realization of the conditions which have been making the business unprofitable with a view to correcting the abuses.

It is necessary that in this movement the trade should realize its own responsibility. The movement to be a success requires the co-operation of the trade through the extension of its loyalty to the manufacturers who operate on a sound business basis instead of bestowing patronage first upon one manufacturer and then upon another because of some extra inducement which is offered temporarily. As a plain case of sound economics, it is pointed out by those interested, the trade should realize that it will be best served by the manufacturer who is making a fair profit and who is operating on an even turn-over basis.

JOBBERS' LAMP STOCKS MORE CAREFULLY ASSORTED

Manufacturers Are Aiming to Accomplish a Better Distribution on an Even Basis—Readjustment of Requirements Under Way

Jobbers in the East have stated that the situation on incandescent lamps has greatly improved since the middle of January. They also said that hereafter conditions would continue to become better and that shortages and stringency had ceased. In fact, by a reassortment of stocks a saving of at least 30 per cent, it is averred, has been effected in the quantity and sizes heretofore carried. Lamp voltages have also been rearranged on standard sizes to the advantage of jobber and dealer, a fact which the user or consumer will appreciate.

When a leading manufacturer was consulted in reference to the foregoing statement he said stocks in the hands of distributers and jobbers had been reassorted. A few sizes rather out of the ordinary in wattage had been eliminated from the regular sizes, but were still carried in factory stock on call. Jobbers and distributers, according to the ELECTRICAL WORLD informant, were required, under their contracts, to submit a quarterly inventory of their lamp sales and merchandise on hand. This practice, it was learned, is the general rule in the trade. The inventories for the quarter ended Dec. 31, 1917, were more carefully scrutinized in view of the many reports that shortages existed in certain sections on particular types and sizes.

It was ascertained that the statement was well founded, but the fault was not factory underproduction but that the manner of distribution was at fault. The manufacturers, it is stated, were therefore satisfied that it was necessary to put into circulation some types and sizes that had been in jobbers' stocks for quite a while without moving. Items that were in this class, while not in great demand in one section, were strong sellers elsewhere where shortages existed. A close study of the situation by expert sales and factory stock managers led to the practical conclusion that a more satisfactory distribution could and should be devised to relieve the pressure and meet the demand on a more equitable basis. This is now under way, and an improvement in the lamp situation is acknowledged by the trade.

Combing over the jobbers' inventories revealed the weakness and error of previous methods of distribution. None of the standard sizes was eliminated, but the requirements of the jobber and distributer were differently assorted. A more even distribution was accomplished. The total production of lamps is held to be ample, and if the new arrangement is followed out to its logical conclusion, it is said, there is no reason for either a pinch or a stringency at any time anywhere. To be sure, there may be a temporary shortage due to extraordinary conditions, as during the past year. This was occasioned by the extraordinary call for the lamp equipment of cantonments, naval bases, aviation fields, shipyards and other large industrial enterprises developed by the war situation. Then local stocks were rapidly absorbed and in a few instances completely exhausted. Manufacturers have been working along these lines, it is stated, for some time; and, aiming at a more even distribution as a basis, the problem is in a fair way of being rapidly solved.

BOILER MARKET BEST IN THE EASTERN STATES

Business Has Slacked Off in Middle West but Is Expected to Revive Soon—Deliveries Six to Eight Months Without Priority Order

The business in boilers of central-station sizes can at present be divided into three general classifications for analysis. They are, first, commercial business in the district between Pittsburgh and New York; second, commercial business west of Pittsburgh, and, third, marine business. East of Pittsburgh inquiries and orders are being handled in volumes above normal. This is due largely to the great amount of strictly war work in that territory, creating extraordinary demands for power that must be supplied. In the Middle West, where there is less war work, the boiler business while still good has fallen off somewhat. The staple buyers of boilers—the central stations—are not in the market for any more equipment than they must of necessity purchase. A better market for boilers in the Middle West is expected to prevail in the coming months regardless of whether the war continues or ends quickly. If the war continues, it seems inevitable that the war business will spread over a wider territory than it now takes in. There are several good fuel fields west of Pittsburgh, and it is believed that the logic of distributing government business more widely, from a geographical standpoint, will become recognized.

This naturally is expected to help boiler business in the Middle West. On the other hand, if the war suddenly stops public-service business is expected to again flourish, since the lack of capital is all that is preventing extensions of plant. The business in marine boilers is so heavy that some of the prominent factories are looking for ways to get the business divided between their competitors rather than trying to do all of the work themselves. On the whole, the boiler manufacturing industry is far behind with its orders. Deliveries on marine boilers are twenty-four months and up; deliveries on commercial boilers are from six to nine months without a priority order. With an A-1 priority order a commercial customer might get a delivery in from two to three months.

Some of the boiler manufacturers are taking advantage of the "sellers' market" that conditions have created to put into effect selling policies that they believe are for the ultimate good of customers but which there was no way of enforcing under ordinary conditions. Manufacturers claim that central stations and some industrial plants are apt to make the mistake of wanting to install boilers that are too large. No boiler in a plant, say these manufacturers, should be so large that its loss in times of peak load will affect the operation of the plant if it is a station that stands alone, or will affect the operation of the system if it is an interconnected plant. In the past all argument to this effect has had little effect on customers. They thought they knew what they wanted and ought to have. In some cases boilers too large for the plant have been sold with a written protest from the manufacturers as a part of the contract. Nevertheless, this has not prevented the customer from coming back on the manufacturer if the boiler went wrong as was predicted. Nothing seems able to prevent that. So at least one company now is making it an absolute rule not to sell boilers that it knows are too large for the plant in which they are to operate. If it cannot convince a customer that he should buy boilers of sensible sizes, it is willing that some other manufacturer should get the business and stand the future grief.

METAL MARKET SITUATION

Consumption of Copper Falls Off a Trifle—Wire Prices Fixed at Base Figures

During the suspension of business on the fuelless Mondays, now happily abrogated, with the exception of New England, the consumption of copper for civilian purposes has suffered a reduction—just how much is now being figured out. At any rate, the call for the metal, which appears to be in good supply, has shaded off, and industrial consumers are supplying their requirements—in less than car lots—at 24.67½ cents per pound, the government price, or perhaps even better. Wire base is unchanged; rubber-covered, cable and weatherproof remain stationary, with probably some slight reduction in the nature of extra discounts under certain favoring conditions.

Straits tin is not to be had—none offering, but Banca, from China, is in fair supply. Prices are very irregular. Lead has moved up a few points; sheet zinc has dropped sharply. The other metals are unchanged.

NEW YORK METAL MARKET PRICES

	Feb. 11	Feb. 18
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	27.00	27.00
Lead, trust price	6.75	7.00
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	15.00
Spelter, spot	7.92½	7.92½
Tin, Straits	*85.00	*85.00
Aluminum, 98 to 99 per cent.	34.00 to 36.00	34.00 to 36.00

OLD METALS

Heavy copper and wire	21.50 to 22.00	21.50 to 22.00
Brass, heavy	14.00 to 15.25	14.00 to 15.25
Brass, light	10.00 to 10.50	10.00 to 10.50
Lead, heavy	6.00 to 6.25	6.25 to 6.50
Zinc, old scrap	5.50 to 5.75	5.50 to 5.75

*Nominal.

THE WEEK
IN TRADE

WITH the appearance of more favorable weather a more wholesome condition is reported in the electrical trade throughout the country. Freight congestions have by no means been relieved—far from it. The Eastern seaboard and North Atlantic coast cities are still suffering from lack of even reasonable deliveries. The abrogation of the fuel order, with the exception of New England, where the shortage is felt severely, has stimulated trade measurably. The transportation of needful raw material along freer lines has helped factory production.

Nevertheless, electrical goods are moving more easily, and the spirit of optimism is loudly expressed. Concretely, fan order contracts are being signed up on a more liberal basis than last year, lamp cord is in strong demand, porcelain insulators are in better supply. Conduit, while below the normal stock level, is on heavy call, as well as electric tools, floodlamps, wire and second-hand motor installations. A scarcity of large motors is predicted, on account of the extended time delivery. Building operations for January show a falling off of fully 50 per cent as against the same month in 1917.

Collections vary from slow to excellent, according as reports concern different branches of the trade. Credits are being held up firmly.

NEW YORK

So important have become deliveries that the careful buyer is not so much concerned by the price of merchandise as by when he will receive it. Delivery is demanded before quotations are asked, and if there is any uncertainty on this score, the order is withheld for further consideration and for other quotations before it is placed. This situation is said to be affecting the sale of all electrical goods. In addition, both jobbers and dealers are continuing to buy cautiously and not far ahead. Locally jobbers, and in some instances manufacturers, are endeavoring to persuade dealers to handle specific lines exclusively. The proposition is not meeting with much favor, it is intimated, as the retailer contends he should sell what is called for irrespective of the make or brand, unless it is universally recognized as standard by the trade and public. Dealers are quoted as being opposed to doing missionary work in the furtherance of any special electrical merchandise. This, they contend, is a function of the manufacturer or exclusive distributer.

LAMPS.—The situation in lamps is said to be improved by the recent action of the manufacturers in the more even distribution of stocks. A saving of 30 per cent is claimed by some jobbers with the new arrangement.

WIRING DEVICES.—Staple goods in this varied line are reported as being in strong supply by jobbers who specialize on isolated plants and like supplies.

POLES.—While prices remain stationary, the difficulty in obtaining supplies grows steadily worse, particularly for chestnut poles of the 35-ft. size, the popular pole, for which an enormous demand is reported. Stocks are low, but a large quantity is on order. Thirty-foot and 40-ft. poles are being substituted, when accepted, as well as white and Northern cedar. This pertains to the Eastern territory only, against which freights are a drawback. An order for 2200 chestnut poles, shipped out of Chicago stock, may be turned into cedar. The embargoes are working a great hardship.

CONDUIT.—Stocks are low owing to traffic conditions. Prices on conduit are not likely to change, and the situation will doubtless improve with the arrival of more propitious weather and the clearing up of freight congestions.

COLLECTIONS AND CREDITS.—No complaint is heard of slow collections, several jobbers asserting that they

would be too good to believe if the actual settlements had not been really checked up. Little credit is being sought and trade acceptances are slowly but surely working their way into trade favor.

VACUUM CLEANERS.—The Hotpoint division of the Edison Electric Appliance Company, Inc., on Feb. 8 issued the following notice: "Because of continued rising cost of material and labor, it is necessary for us to increase the list price on our model L vacuum cleaner and attachments, also on model M attachments. Beginning March 1 to all classes of trade and consumers our new list will be as follows: Model L vacuum cleaners, $30; model L attachments, $8.50; model M attachments, $8.50. Until March 1 orders will be accepted for the above articles at present lists for shipment as may be specified prior to April 1."

LINE HARDWARE.—Following the making of extremely large purchases of line hardware by the government, distributers are of the opinion there will be a tendency to reduce production for commercial consumption. Pittsburgh mills, which have a large quantity of hardware on order, cannot get goods in this market unless subject to long delays. Primary distributers are therefore buying cautiously from Connecticut producers, and not farther ahead than for a month's anticipated requirements.

CONDULETS.—Reports are that condulets are hard to stock and difficult to obtain, excepting in small quantities, in common with everything in the electrical staple line made of steel. Prices are, however, unchanged.

CHICAGO

"What you can get you can't sell, and what you can sell you can't get." Those words from a prominent manufacturers' agent in the Chicago territory sum up rather exaggeratedly, but to some extent accurately, the general state of the trade. Nevertheless, business continues to be done. It is heard everywhere that if prices were at the same level as they were a year ago the volume would be considerably off. As it is the volume of merchandise moving is less than it was at this time last year, but the value appears to be about equal to what it was a year ago. The meeting of the central division of the Electric Supply Jobbers' Association, with its discussions of war conservations and claims and its election of officers, was the feature of the week.

For the week ending Feb. 13 429 electrical permits, aggregating 5293 incandescent lamps and 576 hp., were applied for at Chicago. For the same week last year 803 permits were used. Building permits for the week ending Feb. 13 totaled twelve and amounted to $308,600, as against sixty permits amounting to $831,600 for the same week last year.

MOTORS.—Factories have been notifying certain Chicago agents that motors of 50 hp. and larger will be quoted at 10 months and upward. This indicates a greater scarcity of goods of this kind. War business does not make unusual demands for smaller motors. Immediate deliveries can therefore be made on many sizes and types up to and including 15 hp.

LINE MATERIAL.—The business in pole-line material which is usually anticipated at this time of year, as the result of storms, has in part materialized. Not all of the large stocks laid in to take care of it have been used, however, in spite of the severe weather. This is not regarded as unusual, since the most destructive storms are the sleet storms that usually come later in the year.

PORCELAIN INSULATORS.—The high-tension demand is holding up well, but the electric railway demand is off. Repairs, replacements and a few short extensions are creating the high-tension demand. Some instances in which the need for increased line capacity made it advisable to increase the operating voltages have also resulted in orders. Deliveries are 50 per cent better than last year at this time. Thirty to sixty days are quoted.

DOMESTIC APPLIANCES.—The only complaint concerning business in this field comes from manufacturers whose customers are overstocked. It appears that during the later months of 1917 some dealers were induced to put in very heavy stocks of high-priced goods. In some cases dealers were oversold by manufacturers' representatives seeking records. High-priced material has not moved as rapidly as cheaper goods.

LAMP-DIMMING DEVICES.—There is an active demand for goods of this class. The business has no abnormal war features, but is of the steady, staple variety.

PORTABLE ELECTRIC TOOLS.—The demand for portable electric tools is brisk, but the production was seriously handicapped by the Fuel Administration's order. One concern which ordinarily produces 5500 tools, of both electric and pneumatic types, a month produced last month only about 3200 tools. This large reduction was caused not only by the fact that the production of this particular plant was affected, but also by the further fact that it was impossible to secure the necessary castings because of delays the foundries suffered in getting raw materials, held up by the fuel order. It is said that this condition prevails in spite of the fact that a very large percentage of the tools on order are to be used in shipbuilding and in all sorts of shipyard construction. This concern is about 10,000 tools behind on its orders.

BOSTON

Continued vigorous activity characterizes the trade, with government work the basis of major undertakings. Retailers report a rather quiet week, but plenty of optimism is in evidence as the winter draws toward its close. Labor-saving equipment seems certain to be in increasing demand, and even the small dealers are featuring washing machines and vacuum cleaners with excellent results. Building operations are very quiet and labor for electrical contractors' employ is rather more plentiful. Prices hold firm, with few changes. Deliveries of electrical equipment and supplies are still very unsatisfactory, but continued open weather is alleviating railroad congestion, and the outlook for improved service this spring is encouraging. Jobbers are well stocked, generally speaking. Collections do not show much change, being slow in the case of the smaller contractors, reasonably satisfactory in central-station circles and excellent in the mills.

The coal shortage remains threatening; New England is suffering severely from shutdowns in industrial war production forced by coal scarcity, and there is much unrest among wage earners thrown temporarily out of work. An eight-million-dollar war-storage terminal, including a dock and warehouse with more than 2,000,000 sq. ft. of floor space, is planned for Boston by the War Department, it is announced.

LAMPS.—Carbon lamps are still short, but central-station men do not appear to be much exercised. Some localities report ample supplies of tungsten lamps, judged by reasonable requirements. The outlook is good for increased production and larger factory stocks this spring. One jobber expects to increase his lamp sales by 100,000 this year, due to consignment contracts and list price sales by local central stations.

MOTORS.—Revamping of motor installations is a developing branch of electrical practice. New munitions contracts almost always force machinery rearrangements, and while the demand is great the supply of motors of smaller sizes is improving in extent and variety. Second-hand motor dealers are working under heavy pressure.

TESTING EQUIPMENT.—Plants making testing specialties for laboratories and meter departments are passing through a season of curtailment in new orders, due partly to shortage of testers. Protracted hostilities will probably lead to the increased employment of women in the testing field. Some foreign business is being handled, notably in South America and New Zealand. A representative specialist producer of artificial loads reports ample stocks of magnet wire and copper, with good labor conditions.

CONDUIT.—Scarcity of larger sizes is a widespread plaint, and shipments are slow and uncertain. Forehanded jobbers' orders are gradually coming in, but the situation cannot be called at all satisfactory.

REFRIGERATING EQUIPMENT.—Prospects are good, inquiries in fair volume, prices steady, labor fairly plentiful and deliveries of eight to twelve weeks possible on important work.

ATLANTA

The recent statement by the Fuel Administration that fuelless Mondays would be abandoned, at least for the present, was cheerfully received in this section. While the Southern States were exempted one week earlier than the Northern States, it was anticipated that a rescinding order would follow to cover any territory affected in the original order. The recent mild weather has greatly relieved the fuel situation and surface conditions appear normal.

The trade in general reports that electrical goods from manufacturers' and jobbers' local stocks to interstate destinations in the Southeast are moving more easily. A marked improvement is also noted in deliveries of goods from a few of the Northern and Eastern points. Large quantities of material had been delayed owing to Eastern embargoes. There is no evidence at this time to indicate that business is slowing up; in fact, all manufacturers and jobbers interviewed are very enthusiastic as to the business for 1918. The increased quotas for early delivery of fans reflects material evidence of actual conditions in this line alone.

Industrial activity continues along shipbuilding, essential and quasi-essential lines. The new government dock yard at Fort Wentworth, Ga., will cost approximately $5,000,000. The National Ship Building & Dry Dock Company, Savannah, Ga., has secured a three-million-dollar contract for wooden hulls. The Dayton Company, Dayton, Tenn., capitalized at $4,000,000, will develop iron and coal properties in Tennessee and Georgia. The Cumnock Coal Mining Company, Cumnock, N. C., capitalized at $1,000,000, will develop coal land. Fabricated steel ships will be constructed by the Pensacola Shipbuilding Company, Pensacola, Fla., plant investment approximately $700,000.

LAMP CORD.—The demand for all sizes continues strong. Local stocks seem to be holding up well, and a plentiful supply of the standard size is on hand. Factory deliveries are very slow. Special sizes are very hard to obtain.

SWITCHBOARD INSTRUMENTS.—On the whole the demand has been steady, with the exception of spotty large orders placed with equipment. No change in price has been noted for some time. Shipment promises are very good and vary from four to six weeks.

SOCKETS.—The volume of business in this line is large and the demand shows some increase. Stocks are in pretty fair shape.

TRANSIL OIL.—Manufacturers report great difficulty in securing proper quantities to fulfill transformer orders. This situation is mostly due to rail embargoes.

SEATTLE

From present indications February's trade volumes will be much heavier than last month's, which were surprisingly large. Sewing-machine sales featured the week's business, as has been the case for several weeks. Sales of other labor-saving devices are steady but not startling. The volume of sales of electrical equipment and machinery to shipyards and industrials shows a slight increase over the past week. The buying of electrical machinery and equipment for Alaska canneries is at peak and is expected to subside shortly. It has been heavy. Government buying for navy yard and army cantonments has dragged perceptibly. Stocks, with the exception of conduit, rubber-covered wire, lamps and both large and small motors, are in good shape. The freight situation is no better; shipments are dribbling in very slowly. Shipments which heretofore took eighteen days now take five and six weeks. Car shortage is much in evidence, especially in the Puget Sound district. Portland jobbers report a heavy volume of sales the past week, to wooden shipyards particularly. Steel shipyards are buying steadily.

Convinced that further delay in providing housing for shipyard and like war industry workers will cause slowing down of war essential work, the Seattle Chamber of Commerce will ask the government for $3,000,000 to assist in a home-building campaign. A report to the government states no houses are for rent, a large number being erected for sale only. The residence building boom in Seattle continues, and Tacoma's record for the first eight days of the month was 35 per cent greater than the entire month last year. One Tacoma capitalist plans to erect 500 homes immediately to handle the influx of workers.

The Seattle headquarters of the Emergency Fleet Corporation has received an order for 15,000,000 ft. of fir to supplement a former order of 50,000,000 ft., to be substituted for Southern pine. The railroads have promised co-operation in making shipments promptly.

The boom in grain elevator construction in eastern Washington and Oregon continues. Orders and inquiries for electrical equipment from this source are increasing daily. Several large orders for motors and lighting equipment were placed the past week. The Alaska Engineering Commission of Seattle has awarded contracts for motors, wire and lamps for government railroads. Additional contracts for like equipment will be let shortly.

Conduit is in slightly increased demand from shipyards; government buying receded slightly. Shipments are highly unsatisfactory, on account of the manufacturers' inability to secure closed cars. Stocks low; prices steady. Several large orders for floodlamps for lighting shipyards in the two shipbuilding cities completely shot stocks to pieces, forcing jobbers to wire Eastern factories for additional supply. Additional orders are at hand. Motor generators are moving as fast as jobbers can get them. Shortage has prevailed for several months.

SAN FRANCISCO

Continued rains have greatly improved prospects in California, and the recent strain on business conditions has eased correspondingly. Hydroelectric companies, however, cannot now expect relief, as it is too late to pack and freeze the snow, the melting of which supplies the later summer flow. Thus facing the necessity for returning early to the use of fuel in standbies, and with oil now at $1.50 per barrel and likely to go higher, the central stations are applying for authority to increase rates. A strike of electrical workers in Los Angeles and neighboring cities has been averted by arbitration at the last moment. The labor situation, however, is in a somewhat unsettled state.

Within the last few weeks plans for considerable construction activity have been announced. The one-million-dollar contract for the government camp at Riverside has been let on a percentage basis. Engineers are now at work laying out another government camp, including an aviation base, 12 miles from Sacramento, which will have about fifty-two buildings and will cost about $1,250,000. Work to the value of about $1,000,000 is under way or will soon be started at San Francisco by the State Harbor Commission.

Freight shipments from the East are now coming through in about twenty-eight days. The Southern Pacific Railroad reports that a system of embargoes has resulted in entirely clearing up the congestion of eastbound freight from San Francisco and Los Angeles.

MOTORS.—One large firm reports a readiness to ship from stock in San Francisco all sizes up to 30 hp. Stocks on hand at the factory in these sizes are considered ample, and the small-motor situation is considered to be excellent, in fact better than has been the case previously for more than eighteen months. Deliveries on sizes from 30 hp. to 50 hp. are slow and above 50 hp. are rather indefinite.

LAMPS.—The general situation has not changed materially. No effect of the heatless Mondays in the East has yet been felt on the coast, but in a few weeks, when there has been time for coast lamp orders to come through, there may be greater difficulty in filling orders. A new lamp factory on the coast is to be in service in a few months, after which the situation is expected to be very greatly relieved.

WIRE.—The demand for both rubber-covered and weatherproof wire is reported as below normal. Prices have not changed. For the most part stocks are in bad shape. The completion of factory extensions and a falling off in this business is given as a reason for the decreased demand. However, considerable government business is in prospect. One firm reports a considerable sale of weatherproof to steam railroads.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid

Less than coil.....List to $61.00
Coil to 1000 ft.....10% to 59.17

No. 12 Solid

Less than coil.....List to $71.00
Coil to 1000 ft.....—10% to 68.87

Twin-Conductor

No. 14 Solid

Less than coil.....List to $105.00
Coil to 1000 ft.....$70.00 to 10%

No. 12 Solid

Less than coil.....List to $135
Coil to 1000 ft.....10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid

Less than coil.....List to + 10%
Coil to 1000 ft.....List to 10%

No. 12 Solid

Less than coil.....List + 10%
Coil to 1000 ft.....—10% to 5%

Twin-Conductor

No. 14 Solid

Less than coil.....+ 10% to $115
Coil to 1000 ft.....—10% to $80

No. 12 Solid

Less than coil.....List to + 20%
Coil to 1000 ft.....—10% to 5%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....10% to $24.00
1/5 to std. pkg.....20% to 19.80
Std. pkg.....34% to 18.75

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....+20% to 12%
1/5 to std. pkg.....20% to list
Std. pkg.....34% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.285	.295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
3/8-in. s. stp.	Net to $75.00	—15% to $69.75
3/8-in. d. stp.	+10% to 75.00	List to 72.00
1/2-in. s. stp.	List to 100.00	—15% to 93.00
1/2-in. d. stp.	+10% to 100.00	List to 96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.75
3/8-in. double strip	78.75	71.25-71.75
1/2-in. single strip	100.00	85.00
1/2-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $25.00-$55.00	$20.50-$24.50	$20.00-$21.50
1/4-in.— $28.00-$60.00	$22.50-$27.00	$22.00-$23.50

NET PER 1000 FT.—CHICAGO

Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in. $36.00-$55.00	$25.00-$37.50	$22.50-$24.75
1/4-in.— $40.00-$60.00	$27.00-$30.00	$25.00-$27.00

CONDUIT, COUPLINGS AND ELBOWS. RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37
2 1/2	.58 1/2
3	.76 1/2

	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in
Less than 2500 lb.	4% to 6%	7% to 9%
2500 to 5000 lb.	6% to 8%	9% to 11%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 in. to 1/2 in.	3/4 in. to 3 in
Less than 2500 lb.	1.3% to 4.7%	4.3% to 7.7%
2500-5000 lb.	3.3% to 6.7%	6.3% to 9.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price.....$5.00 to $6.00
Discount.....30%

CHICAGO

List.....$5.00
Discount.....25% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....28%
1/5 to std. pkg.....38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....28%
1/5 to std. pkg.....38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.30
60-watt—B	100	.35
100-watt—B	24	.70
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.53
25-watt—G 25	50	.55
40-watt—G 25	50	.55
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.77
Round bulbs, 4¾ in., frosted:		
100-watt—G 35	24	1.10

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$24.90 to $31.00
Coil to 1000 ft	22.72 to 27.90

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$29.00 to $35.60
Coil to 1000 ft	21.50 to 26.70

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$24.00 to $25.75

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%-37%	20%-32%
$10.00 to $50.00 list	42%-45%	37%-40%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N. C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10 to $11.40	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push		
¼-in. cap key and push sockets	500	$0.33
¼-in. cap keyless socket	500	.30
¼-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net to $23.00
1/5 to std. pkg.	20% to 21.00

NET PER 100—CHICAGO

Less than 1/5 std. pkg.	14% to $25.00
1/5 std. pkg.	30% to 23.00

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	11%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	Net
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25%	20%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List price	$4.50 to $6.00
Discount	25% to 30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44¼
No. 18, full spools	0.43¼

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.57½ to $0.64
No. 18, full spools	0.50 to 0.54

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11	$15.00-$18.00	$13.00	$10.25-$11.50
12	23.25- 25.41	21.30- 21.78	15.97- 19.35
10	32.40- 35.21	29.70- 30.18	22.13- 27.00
8	45.70- 49.12	41.90- 42.12	30.88- 38.00
6	72.40- 77.84	66.35- 66.72	48.93- 60.30

CHICAGO

	Price per 1000 Ft. Net—		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00	$13.00-$13.50	$11.50-$12.00
12	25.33-$26.28	22.48- 25.33	20.40- 20.93
10	35.04- 36.54	30.03- 31.26	28.23- 29.23
8	48.97- 51.57	41.98- 44.13	39.42- 41.36
6	66.46- 88.38	66.43- 75.61	56.39- 70.70

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$33.25 to $35.25
25 to 50 lb.	31.25
50 to 100 lb.	28.25 to 34.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$35.50 to $40.35
25 to 50 lb.	34.50 to 39.35
50 to 100 lb.	33.50 to 38.35

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Master Switch

The master switch shown herewith has a lever which controls the starting and a press button in the front for stopping. In the running position the starting lever is held by an electromagnet which is in series with the field

WITH LEVER FOR STARTING AND BUTTON FOR STOPPING

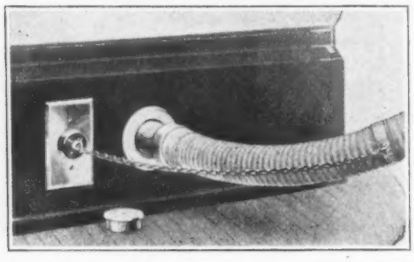
winding of the motor, so that in case of a failure of voltage or a rupture of the field circuit the starting lever automatically flies to the "off" position.

This switch is made by the Igranic Electric Company, Ltd., London, Eng.

Automatic Control for Stationary Vacuum Cleaner

Stationary vacuum cleaners when installed in large apartment buildings, hotels, club houses and halls have hose connections in many locations and switches on each floor to start and stop the cleaner. With such a system an employer or tenant using a cleaner connection on one floor and knowing that others are being used elsewhere in the system depends on the others to close down, with the usual result that the plant continues to run unnecessarily.

The Cutler-Hammer Manufacturing Company of Milwaukee, Wis., has designed a vacuum-cleaner receptacle the

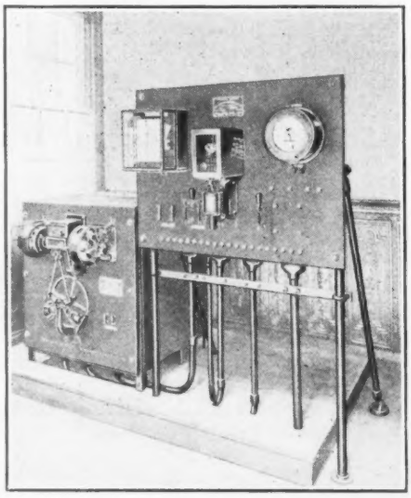


VACUUM CLEANER RECEPTACLE AND CONTROL

cap of which is attached to the hose, as shown in the accompanying illustration. Inserting the cap in the receptacle closes an auxiliary circuit to the starting equipment. In the case of small stationary outfits in private homes the cap can be used to close the motor circuit direct. This automatic control insures against waste of electricity and unnecessary operation of the cleaner. These receptacles are wired in parallel so that the insertion of one or more caps will operate the plant. Being chained to the hose, the cap will always be there when the use of the hose is required. The receptacle and cap furnished are of a special design which permits the cap to be readily detached at any angle. No other cap is interchangeable with it, and consequently the receptacle cannot be used for other purposes. The complete device includes receptacle, cap and 14 in. (35.6 cm.) of chain but not the hose clamp.

Meter for Measuring Coke Oven Gas

Increasing quantities of surplus gas from by-products coke-oven plants are being consumed in various processes in steel mills, and it is desirable to have



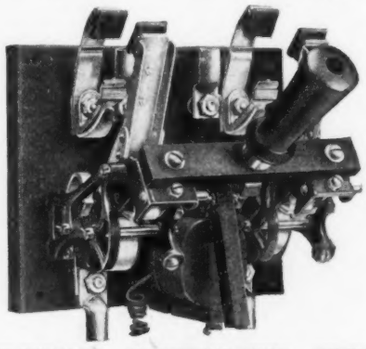
RECORDING PANEL INSTALLED IN OFFICE

an accurate and reliable measurement of this gas. For this purpose the Thomas meter has been applied, which measures the quantity of gas in standard units, such as cubic feet at 30-60, without any calculations or corrections for pressure and temperature, although these may vary through wide ranges. The total quantities (in cubic feet) are shown on an integrating meter, and the rate of flow is shown graphically on a curve-drawing instrument. The graphic chart obtained from this instrument is very useful to the superintendent of a coke-oven plant, showing him at a glance the amount of gas being used for fuel in the coke ovens over any period, with variations in quantities clearly indicated.

The meter is installed in a housing which replaces a portion of the gas-pipe line. The principle of the Thomas meter is that it measures the heat capacity of a gas electrically. The amount of electric heat necessary to raise a standard unit 2 deg. is used as a measure of the gas flowing through the meter. The electricity for heating the gas can be conducted on comparatively small wires, consequently the meters showing the amount of gas used can be placed in the superintendent's office or other desired location, which may be several hundred feet from the meter proper. The recording panel is shown herewith as installed in the office of the rolling-mill superintendent of the Brier Hill Steel Company at Youngstown, Ohio. The graphic chart shows at a glance just how much gas is being used at any time in the steel mill. The complete Thomas meter and recording panels are made and installed by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis.

Circuit Breakers

The Roller-Smith Company of 233 Broadway, New York City, has brought out an inclosed-type plain no-voltage circuit breaker. It is pointed out that these breakers are now mounted in inclosing cases. The outfit complete comprises the circuit breaker, the inclosing case, which is provided with wiring inlets at the top and bottom, a convenient handle with which the breaker may be opened by a slight upward pressure or closed with a slight downward pressure, and a target on the left side of the case showing

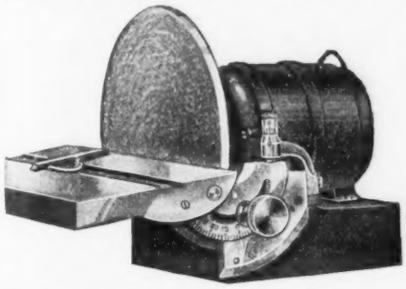


NO-VOLTAGE INDUSTRIAL-TYPE CIRCUIT BREAKER WITHOUT INCLOSING CASE

whether the breaker is open or closed. The equipment is offered for 45-amp. and 100-amp. loads and voltages of 110, 220, 312 and 440. Each breaker has one no-voltage coil, which is wound for the voltage specified.

Motor-Driven Sanders

The Electric Specialty Company of Stamford, Conn., has developed the speed sander shown here, which is driven by an alternating-current or direct-current motor. The motors used are said to be dust-proof, with shafts over-

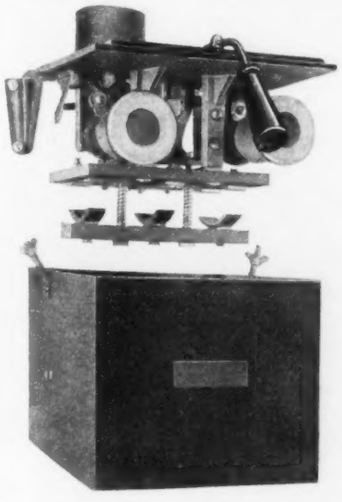


EQUIPPED WITH A MICROMETER ADJUSTMENT

size, running in ball bearings. The steel disks are turned and ground accurately on all surfaces, insuring perfect balance. This machine is equipped with a micrometer adjustment which when turned one space tips the table 0.001 in. on 1-in. (0.0025 cm. on 2.54-cm.) thickness. This is a great convenience in duplicating one bevel against another, it is said. The micrometer also acts as a positive right-angle stop, so that the table can be kept perfectly square with the disk.

Motor-Starting Switches

Motor-starting switches designed for low-voltage and over-load protection are made by the Wells-Morris Manufacturing Company, 90 Second Street, San Francisco, Cal. These switches, equipped with protective plugs (inverse-time-limit design) of proper size, give both inverse-time-limit overhead protection and low-voltage protection.



DESIGNED FOR LOW-VOLTAGE AND OVER-LOAD PROTECTION

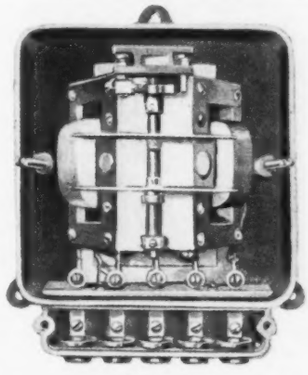
They also protect polyphase motors from operating single-phase. The switches are furnished with left-hand threaded receptacles to receive the protective plugs.

These switches are quick-break, opening by gravity, spring-assisted. Each pole has two breaks in series and wiping contacts with a special member to take the arc. The contacts will not freeze closed, it is claimed. They open automatically when the power is interrupted or if a protective plug blows, giving absolute protection against overload and single phasing. The low-voltage release coil uses only a small amount of energy and is positive in its method of operation.

Reverse Phase Relay

Reverse phase relays for the protection of elevators, cranes, conveyors, textile machinery, etc., are sold by the Philadelphia Electric Company Supply Department of Philadelphia, Pa. The complete equipment consists of the relay and a double-pole circuit breaker equipped with a shunt trip coil only. The relay is a potentially operated device, consuming but a negligible amount of energy.

The electrical elements consist of two laminated iron electromagnets, the coils of which are connected to opposite phases of the supply circuit. A vertical shaft supported by bearing pivots carries two aluminum sectors,



RELAY WITH CASING REMOVED

which are partly inclosed by air gaps in the magnetic circuit. The magnets are so placed that when energized from a polyphase circuit a rotating field is produced. This field, acting upon the sectors, causes the latter to rotate in a direction dependent upon the phase rotation of the supply circuit. A contact attached to the shaft and receiving the current through a flexible connection completes the trip-coil circuit of the accompanying circuit breaker when the direction of phase rotation is of such a kind as to cause the relay to operate.

The relay may be supplied to either close or open a circuit, such as that supplying the no-voltage release coil of an oil switch or circuit breaker. The device is mounted in a substantial dust-proof iron case, with sealable wing nuts, and terminal chamber having binding posts for the connection leads.

This relay is designed for use on two-phase or three-phase, three-wire or four-wire, 25-cycle or 60-cycle circuits, and will be furnished for 110, 220, 330, 440, 550 and 600 volts service.

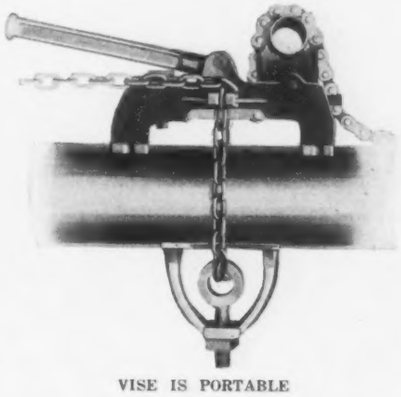
The circuit breakers furnished with these relays are of special design either of a totally inclosed oil type or of a plunger type with iron inclosing box with relay mounted thereon. The capacity of the breakers has been standardized at 100 amp. and 220-600 volts, which at the 220-volt rating will take care of motors up to and including those of 30-hp. capacity. Larger capacity circuit breakers can, however, be furnished.

Pipe Vise

The pipe vise shown herewith is a simple, portable vise which can be moved from one location and mounted at another in a moment's time. It fastens to any kind of a horizontal or vertical support, whether round, square or flat, without the use of bolts. It locks any size of pipe or conduit within its limits by the slight push of a lever. No previous adjustment is necessary.

The base support is squared out in the form of an inverted V, at the sides of which are bolt lug feet, to be used only in case the vise is to be permanently bolted in one position. Hence it will conform to a round, square or flat surface. A clamp support on the opposite side of the column is a part of the equipment. It is a bell-section shape, having a boss at the top, through which a threaded supporting eye-bolt passes free. A heavy nut resting on the top of the boss and engaging the threaded eye-bolt adjusts the tension of the chain passing through the eye of the eye-bolt. The base of the clamp support is squared out in a manner similar to the vise base in such a way that it fits the same shaped surfaces.

A heavy wrought-iron chain is riveted on one side of the vise base. It passes around the supporting column, through the eye of the eye-bolt in the clamp support, and thence to the other side of the vise base, a link being held securely in position in a socket. Tightening of the eye-bolt nut tightens the



VISE IS PORTABLE

supporting chain and holds the vise rigidly in position.

The Gerolo Manufacturing Company, Old Colony Building, Chicago, is the manufacturer.

Trade Notes

L. L. FLEIG & COMPANY, INC., of Chicago announces that it has raised its capital stock from $30,000 to $50,000. The company handles electrical insulating materials.

M. V. STAGG, formerly with the Fort Wayne & Northern Indiana Traction Company, is now manager of the appliance sales department for the F. Bissell Company, Toledo, Ohio.

THE WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis, Mo., has insured its 3000 employees, up to $1,000 each, for 1918. The company pays the premium on the entire amount of insurance.

J. KING WALLACE, formerly with the Continental Fibre Company, is now district manager for the Consumers' Rubber Company, Cleveland, Ohio, covering the States of New York, Pennsylvania and Maryland.

HOWARD DINGLE and W. W. Clark, formerly manager and assistant manager of the Crocker-Wheeler Company, Ampere, N. J., have formed the Dingle-Clark Company, contracting engineers, with headquarters at 536 Engineers' Building, Cleveland, Ohio.

S. M. MOORE, for six years in the New Haven (Conn.) office of the General Electric Company, has joined the staff of the New England Engineering Company of Waterbury, Conn. He has been placed in charge of office work in connection with motor and apparatus sales.

THE GENERAL ELECTRIC COMPANY of Lynn, Mass., on Feb. 5 distributed bonuses to about 13,000 employees who have worked continuously for it for five years. Five per cent of the total earnings of the past six months was paid, and the total amount disbursed was about $100,000.

SCHWEITZER & CONRAD, INC., of Chicago, has recently appointed the Franklin Sales Company, Denver, Col., district representative for Wyoming, Colorado, New Mexico, Arizona, Utah, the western portion of Nebraska and the eastern portion of Montana and Idaho. The Franklin company will sell the entire line of S. & C. protecting and switching devices.

THE NATIONAL X-RAY REFLECTOR COMPANY of Chicago has appointed G. F. Evans supervising engineer in the territory comprising the State of Ohio (except Toledo and Cincinnati), West Virginia and Western Pennsylvania. Mr. Evans is established at 825-826 Columbus Savings & Trust Building, Columbus, Ohio. He was formerly connected with the W. C. Moore Company of Columbus.

CHARLES H. KEELING, after years of experience in the electrical field, has joined the selling forces of the Square D Company of Detroit, Mich., and will travel in the Canadian territory, with headquarters at Toronto. He was formerly connected with the Renfrew Electric Manufacturing Company, Ltd., Renfrew, Canada, being its first sales representative. In 1916 Mr. Keeling was appointed sales and advertising manager of that company.

THE DE LA VERGNE MACHINE COMPANY of New York City, since its control by the William Cramp & Sons Ship & Engine Building Company, because of the large amount of turbine work, will somewhat curtail its oil-engine and ice-machine business. The company states that for ice machines there is little or no outlook for the next year or more, as the government is conserving the ammonia supply to the extent of not permitting its use in new plants.

HICKEY & SCHNEIDER, INC., New York City, manufacturer of transmission-line equipment, heretofore a partnership, is now to be continued as a corporation, capitalized at $100,000, according to a statement made by Mr. Schneider, president of the concern. P. Kovac, formerly with the New York Edison Company, is sales engineer in charge of the company's sales and service departments. P. S. Houton, an engineer of broad experience, is to handle the design work.

EARL E. EBY, manager of the industrial bearings division, Pittsburgh office of the Hyatt Roller Bearing Company of Newark, N. J., for the past two years, has been appointed assistant sales manager, with offices in the Metropolitan Tower, New York City. Mr. Eby is a graduate engineer from the Ohio State University and previous to his connection with the Hyatt company spent four years in the engineering department of the Westinghouse Electric & Manufacturing Company.

THE NATIONAL X-RAY REFLECTOR COMPANY as the result of a suit brought in the United States District Court, southern district of New York, against the Stransky Manufacturing Company, for infringement of the "X-ray" trade-mark by putting out a lighting fixture called the "X-Ray-Lite," has received a decree holding the X-ray trade-mark good and valid and granting a perpetual injunction restraining the defendant from infringing it.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., will remove its automobile equipment department manufacturing operations to the company's Newark (N. J.) works. At these works the Westinghouse company has for many years been manufacturing small motors and instruments of accuracy and precision. Its facilities and staff assure a continuation of the present high quality of the automotive equipments. At the same time the general sales offices of this department will be moved to 110 West Forty-second Street, New York City, where the Eastern district sales oifice will also be. S. D. Levings has resigned as Eastern representative of the automobile equipment department.

THE SQUARE D COMPANY of Detroit, Mich., held its first annual sales convention at the Hotel Statler Jan. 10, 11 and 12. It was attended by the company representatives from coast to coast and members of the advertising and home sales force. Bryson D. Horton, president of the company, made the opening address; A. MacLachlan, sales manager, gave a talk on "The Industrial Plant"; L. D. Calhoun, advertising manager, and G. H. Eddy, with the ELECTRICAL WORLD, also spoke on timely topics. A dinner tendered by President Horton was given the guests on the evening of the 11th at the Detroit Athletic Club. A trip of inspection through the plant was made the following day.

Trade Publications

FANS.—The Carleton Company, 170 Summer Street, Boston, Mass., is distributing a leaflet descriptive of its fans for the 1918 season.

FANS.—The Hamilton-Beach Manufacturing Company of Racine, Wis., has prepared a leaflet descriptive of its Cyclone universal fan.

FANS.—The Pittsburgh Electric Specialties Company, 396 Broadway, New York City, has prepared a leaflet descriptive of fans for 1918.

CIRCUIT BREAKERS.—The Cutter Company of Philadelphia is distributing a calendar. Various interesting information and data regarding this company's line of circuit breakers are included in this calendar.

FANS.—The Robbins & Myers Company of Springfield, Ohio, has prepared its catalog No. 1117, descriptive of its electric fans for alternating-current and direct-current circuits, including non-oscillating, oscillating, ceiling and ventilating fans and hat cleaning motors.

ILLUMINATING GLASSWARE. — The Phoenix Glass Company, 230 Fifth Avenue, New York City, is bringing out a monthly publication to be known as the *Illuminator*, which will deal mostly with matters pertaining to illuminating glassware. All new designs will be shown on perforated and punched pages which can be easily removed and filed away in a loose-leaf data book. This will permit all the new designs to be kept together and will not require the going over of the files of the *Illuminator* each time reference is to be made. All changes in discounts, package charges, etc., will be noted. Articles by fixture manufacturers and illuminating engineers on various problems that they have actually met and solved will be featured. In this first issue an article on a new cost system installed by Cassidy & Son Manufacturing Company contains much information that is valuable to the fixture manufacturer. Articles will be published by the leading designers in the country on various subjects dealing with the artistic features of glassware and fixtures.

STEAM TURBINES.—Interesting applications of steam turbines in naval public utility and industrial service are illustrated in bulletin 242, just issued by the Terry Steam Turbine Company of Hartford, Conn. In this twenty-eight-page publication the advantages of turbine drive for auxiliaries are featured, followed by a clear-cut description of the Terry wheel and principle of operation, with diagrammatic explanation of the action of steam, reasons for selecting this product and a condensed engineering discussion of eleven cardinal points in design. A full-page illustration of labeled turbine parts is included, and an interesting diagram is added showing the relative water rates with and without the use of partial nozzle control. The principal engineering features bearing upon turbine selection are set forth in simple terms easily understood by the industrial executive and sufficiently complete in detail to interest the technical reader. Shaft whipping, maintained alignment, handling fractional loads efficiently, low upkeep cost and reliability are a few of the points discussed. Applications of the vertical type of unit used for the past decade on United States destroyers, late advances in turbines giving various classes of pumping service handled by this equipment, generating units, duplex exciters and fans of the turbine-driven type are featured in the bulletin.

New Incorporations

THE GENERAL UTILITY COMPANY of Dunn, N. C., has been chartered with a capital stock of $100,000 by B. O. Townsend, Marvin L. Wade and G. M. Tilghman.

THE DOMESTIC ELECTRIC APPLIANCE COMPANY of Peoria, Ill., has been chartered with a capital stock of $25,000 by R. B. Cherry, V. E. Hopkins and E. G. Kuecks.

THE COMMONWEALTH WATER & ELECTRIC COMPANY of San Beniti, Tex., has been incorporated with a capital stock of $30,000 by John T. Lomax, W. D. Carpenter and S. Spears.

THE GOWER-MASON ELECTRIC COMPANY of Greenville, S. C., has been incorporated with a capital stock of $35,000. The officers are: DuPont Guerry, Jr., president, and R. S. Huntington, secretary and treasurer.

THE LANDIS ELECTRIC COMPANY of San Diego, Cal., has been incorporated by H. G. Landis, Edward Jewell and Arthur J. Simpson. The company is capitalized at $25,000 and proposes to manufacture electrical specialties.

THE HYLE ELECTRIC SERVICE, Inc., of Buffalo, N. Y., has been incorporated with a capital stock of $3,000 by Howard D. Hyle, Irving R. Templeton and J. Francis Carter. The company proposes to manufacture storage batteries.

HUNTING & GUERRY of Greenville, S. C., has been chartered with a capital stock of $50,000 to do an electrical contracting business. The officers are: R. S. Huntington, president, and DuPont Guerry, Jr., secretary and treasurer.

THE MONTEREY (IND.) LIGHT & POWER COMPANY has been incorporated by Charles M. Stern, William H. Vandenberg and V. H. Surghnor. The company is capitalized at $60,000 and proposes to distribute electricity for lamps and motors.

THE BENSON ELECTRIC COMPANY of New York, N. Y., has been chartered with a capital stock of $250,000 by H. S. Leman, R. Goldman and A. H. Bloch, 507 Westminster Square, Brooklyn, N. Y. The company proposes to manufacture specialties.

THE HOME ELECTRIC COMPANY of Hendersonville, N. C., has been incorporated with a capital stock of $500,000 to construct and operate interurban railways. The incorporators are: William H. Oates, Claudia H. Oates and Anne Oates, all of Hendersonville.

HESS & HICKS, Inc., of New York, N. Y., have filed articles of incorporation with a capital stock of $5,000 for the purpose of doing a general electrical and mechanical engineering business. The incorporators are: Julia F. Hess, Frank F. Hess and Gary Hicks.

THE F. D. SCHUSSLER MANUFACTURING COMPANY of New York, N. Y., has been incorporated by F. D. Schussler, T. C. Miller and T. Moran, 259 Eighty-first Street, Brooklyn, N. Y. The company is capitalized at $100,000 and proposes to manufacture tools, electrical goods, etc.

THE REMINGTON ELECTRIC WELDER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $300,000 to manufacture electric welders. The incorporators are: Martin E. Smith, Artemus Smith, M. E. Doto, all of Wilmington, Del.

THE WELLENS-KINTO CLOCK COMPANY of Philadelphia, Pa., has been incorporated with a capital stock of $100,000 by F. R. Hansell, Land Title Building, Philadelphia, and S. C. Seymour of Camden, N. J. The company proposes to manufacture motor-driven clocks and other automatic equipment.

New England States

PITTSFIELD, MASS.—Arrangements are being made by John F. Cooney, owner of the Union Square Theater, for the installation of an electric-light and power plant. Contract has been placed for a 200-amp. Westinghouse electric generating unit.

SPRINGFIELD, MASS.—The question of petitioning the State Legislature for authority to develop the water power of Little River to supply electricity for municipal purposes is under consideration by the City Council.

NEW LONDON, CONN.—The Standard Brass & Copper Tube Company, Woodbridge Street, is installing a new power plant in connection with an addition to its rolling mill.

Middle Atlantic States

ALBANY, N. Y.—Plans are being considered by the Esco Electric Company for rebuilding the portion of its plant at 368 Broadway, recently destroyed by fire, causing a loss of about $75,000. The new building will cost about $50,000.

AUBURN, N. Y.—Plans have been prepared by the New York Telephone Company, 15 Dey Street, New York, N. Y., for the construction of a new telephone exchange building on South Street.

BROOKLYN, N. Y.—Charles Pfizer & Company of Brookilyn are planning to erect a one-story boiler house, to cost about $15,000, at their works at 11 Bartlett Street.

BROOKLYN, N. Y.—Application has been made by the Kings County Electric Light & Power Company to the Public Service Commission for permission to issue $1,000,000 in bonds, to provide for extensions, improvements, etc.

BROOKLYN, N. Y.—The Krantz Manufacturing Company, Seventh Street, near Second Avenue, manufacturer of electrical supplies, has filed plans and awarded contract to the Werner-Huberty Company, 50 Court Street, Brooklyn, for erection of an addition to its plant to cost about 35,000.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 25, under specifications (No. 2826) for installing an electric elevator and dumbwaiter at the naval hospital at the Brooklyn Navy Yard. The cost is estimated at $6,500. Bids will also be received at the same time under specifications (No. 2825) for a diet kitchen and refrigerating equipment at the naval hospital, Brooklyn.

BROOKLYN, N. Y.—The United States government has leased property, consisting of a tract bounded by Second and Third Avenues, Twenty-ninth and Thirty-second Streets, South Brooklyn, from the Bush Terminal Company and the city of Brooklyn, on which it will erect several large factories for the manufacture of products for army service. Plans, it is said, are being prepared for the construction of two initial buildings, each eight stories, U-shaped, about 200 ft. by 75 ft., with 75-ft. wings. Warehouses will also be built for shipping service.

GREENWICH, N. Y.—Application has been filed with the Public Service Commission by the Consolidated Electric Company of Greenwich for permission to construct and operate an electric-light plant in Northumberland. The company proposes to construct an electric transmission line, 3 miles long, from the Northumberland Bridge through Bacon Hill and along the highway leading from Bacon Hill to Grangerville. The necessary local franchises have been obtained by the company.

LONG ISLAND CITY, N. Y.—Plans have been filed by the Astoria Light, Heat & Power Company for the erection of a new plant, 44 ft. by 175 ft., on Winthrop Avenue, to cost about $20,000.

NEW YORK, N. Y.—Ernest & Herman Levy, Fourth Avenue and Nineteenth Street, it is reported, are planning to erect a new power plant in connection with their proposed new silk mill, to be located at Purdy and O'Dell Streets. The cost of the entire project is estimated at $75,000.

NEW YORK, N. Y.—Preparations are being made by the West Virginia Pulp & Paper Company for extensions to its different plants, involving an expenditure of about $1,000,000. Contract has been awarded by the company for the construction of eight new buildings at Tyrone, Pa., to form a new unit for the present works there. At Piedmont, Va., a similar plant will be erected by the company, at a cost of about $300,000 and four new buildings will be built at its Mechanicsville, N. Y., plant.

ROCHESTER, N. Y.—The Wheeler-Green Electric Company has filed notice with the Public Service Commission of an increase in capital stock from $100,000 to $500,000, to provide for extensions, etc.

ROCHESTER, N. Y.—Preliminary plans are being prepared by F. L. Raschig of Cincinnati, Ohio, for the city of Rochester for the construction of an electric railway (8 miles long) through the old bed of the Erie Canal, to cost about $8,000,000.

WATERVILLE, N. Y.—The Village Trustees have awarded the Waterville Gas & Electric Company a contract for lighting the streets of the village for a period of two years and 11 months. Under the terms of the new contract the company is to install 40 Mazda lamps, 20 of 100 cp. and 20 of 250 cp.

CAMDEN, N. J.—The construction of a municipal electric-light plant is being considered by the city officials.

CLOSTER, N. J.—The Rockland Electric Company of New Jersey has been granted permission by the Board of Public Utility Commissioners to issue $80,000 improvement gold notes.

DOVER, N. J.—The New Jersey Power Company has secured a contract to supply energy to operate the plant of the Somerset Stone Crushing Company (replacing steam power) at Bernardsville. About 60 hp. in motors will be required.

NEWARK, N. J.—Plans have been filed by the General Lead Batteries Company, 4 Lister Avenue, for the construction of an addition, 50 ft. by 80 ft., at its plant.

NEWARK, N. J.—A permit has been taken out by the Butterworth-Judson Corporation, Avenue R, for the construction of a one-story boiler plant addition, 55 ft. by 110 ft., to cost about $25,000, at its chemical works.

NEWTON, N. J.—The Town Committee is considering making improvements to the fire-alarm system.

POMPTON LAKES, N. J.—Plans are being considered by the Board of Education for the immediate installation of new electric-lighting systems throughout the school buildings.

TRENTON, N. J.—Plans are being considered for the installation of a new refrigerating plant at the New Jersey State Hospital at Morris Plains, for which bids will be received until Feb. 26. Francis H. Bent is state architect.

TRENTON, N. J.—Plans are being prepared for the installation of a new power plant to cost about $15,000, in connection with the construction of the first unit of the proposed new general hospital. William A. Kleman is city architect.

WEST NEW YORK, N. J.—The Town Council is considering a bond issue of 150,000 for the installation of a municipal electric-light plant.

BIRDSBORO, PA.—The Birdsboro Electric Company is erecting a high-tension transmission line to the mines of the Brooke Iron Company at French Creek to supply energy to operate machinery in the mines there.

CARLISLE, PA.—Plans are being considered by the City Council for improvements to the fire-alarm system.

CLIFTON HEIGHTS, PA.—Plans have been prepared by the Kent Manufacturing Company for the construction of a steam-driven electric power plant, one story, 40 ft. by 68 ft., to cost about $50,000.

DERRY, PA.—The plant of the Pittsburgh High Voltage Insulator Company was badly damaged by fire recently. The company manufactures high-tension insulators, etc.

ERIE, PA.—An ordinance providing $22,500 for completing the conduit system and the new lighting system along State Street has been submitted to the City Council. The conduits will be placed on State Street with extensions out Twelfth Street to Walnut and Front Streets to connect with the new plant of the Erie Lighting Company.

GROVE CITY, PA.—Plans have been filed by the Grove City Creamery Company for the construction of a new plant and power house, to cost about $35,000. Contract has been awarded to Rose & Fisher, 1719 Pennsylvania Avenue, Pittsburgh.

HARRISBURG, PA.—Notice has been filed with the Public Service Commission by the Juniata Public Service Company of an issue of $300,000 in bonds. This company recently acquired a number of electric companies operating in the Susquehanna and Juniata Valleys.

HARRISBURG, PA.—The Harrisburg Railways Company is planning to place its new substation in operation soon to provide power for its Second, Third and Fourth Street traction lines. Three new large transformers will be installed immediately to utilize energy from its York Haven plant.

PHILADELPHIA, PA.—Contract has been awarded by the Bell Telephone Company for proposed alterations and improvements in its building at Eleventh and Filbert Streets to Albert Zellfelder of Philadelphia.

PHILADELPHIA, PA.—Contract has been awarded to F. B. Davis of Philadelphia by Shane Brothers & Wilson Company, Sixty-third and Market Streets, for the construction of a new power house, 35 ft. by 45 ft., at its plant.

PHILADELPHIA, PA.—Plans are being prepared by Andrew J. Sauer & Company of Philadelphia for the construction of a power house to be erected by I. S. Leberman at his plant in the Kensington district, to cost about $10,000.

READING, PA.—The Metropolitan Electric Light Company is extending its electric transmission lines from the Birdsboro Stone Company at Six Penny to the French Creek Mines.

TRAPPE, PA.—The Borough Council has awarded the Counties Gas & Electric Company of Norristown a contract to supply an electric street-lighting service in the borough of Trappe.

WILLIAMSTOWN, PA.—Notice has been filed with the Public Service Commission by the Lykens Valley Light & Power Company of an issue of $15,000 in bonds, the proceeds to be used for improvements.

DOVER, DEL.—Plans have been prepared for alterations and extensions to the local plant of the Diamond State Telephone Company.

MONKTON, MD.—The construction of a hydroelectric power plant on Gunpowder River, to cost about $25,000, to furnish power to operate the proposed flour mill to be erected for the Monkton Roller Mills, is under consideration. The plans provide for the construction of a dam and power house to develop about 100 hp. Otis E. McCoy of Mount Washington is president.

CHARLESTON, W. VA.—Plans for the reconstruction of the boiler house at the State University at Charleston, which was recently destroyed by fire, are under consideration by the trustees of the university.

WHEELING, W. VA.—The car barns and rolling stock of the Wheeling Traction Company were destroyed by fire recently, causing a loss of about $200,000.

WARRENTON, VA.—The Warrenton Electric Light & Ice Company is changing its plant from direct to alternating current. Two small direct-current generators have been taken out and two alternating-current generators having a total capacity of 90 kw. have been installed. M. J. O'Connell is manager.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 25, under specifications (No. 2822) for electric-light and power system at Anacostia, D. C., to cost about $16,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 1, for furnishing and installing lighting fixtures in the United States post offices at Aledo, Ill.; Altus, Okla.; Berwick, Pa.; Butler, Mo.; Cambridge, Md.; Cherryvale, Kan.; Durant, Okla.; Fitzgerald, Ga.; Gallatin, Tenn.; Glenwood, Iowa; Hoopeston, Ill.; Indiana, Pa.; Marion, Ill.; Monessen, Pa.; Olney, Ill.; Sanford, Fla.; Vernon, Tex.; Waynesboro, Va.; Willow, Cal., and the United States post office and court house extension at Oklahoma City. Specifications may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Brooklyn, N. Y., Schedule 1685—12,000 ft. leaded and armored, interior communication cable, 90,000 ft. leaded and armored single-conductor wire. Puget Sound, Wash., Schedule 1684—50 portable ventilating sets; Schedule 1682—50,000 ft. lighting and power wire; Schedule 1685—5000 ft. leaded and armored two-conductor lighting and power wire. Various, Schedule 1688—Miscellaneous hard spring brass wire, miscellaneous soft copper wire, miscellaneous phosphor-bronze wire. Applications for proposal blanks should designate the schedule desired by number.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

BUCYRUS, OHIO.—A committee has been appointed by the Chamber of Commerce to look into the matter of establishing another power plant in Bucyrus.

ST. PARIS, OHIO.—An election will soon be called to submit to the voters the proposal to issue $5 500 in bonds for improvements to the electric-light plant.

SPRINGFIELD, OHIO.—Work, it is reported, will begin on the construction of a large power plant and storage house at the plant of the Robbins & Myers Company, to cost about $100,000. It will be located on Nelson Street about 750 ft. from the main factory.

WILLARD, OHIO.—Contract has been awarded for a 150-kva., 60-cycle alternator, directly connected to a Chuse non-releasing Corliss engine for the municipal electric-light plant. R. D. Smith is superintendent and electrician.

WINCHESTER, KY.—The city of Winchester is contemplating equipping its proposed new water-works system with electrically operated machinery, for which plans are now being prepared. A committee will soon be sent to Washington to negotiate with the United States government for a permit to install water turbines at Lock No. 10 on the Kentucky River, to develop power to operate the pumps and machinery in the plant.

JEFFERSONVILLE, IND.—Plans are under consideration for rebuilding the State Reformatory at Jeffersonville, of which a large part was destroyed by fire on Feb. 6, causing a loss of between $500 000 and $750,000, including trade shops, raw and finished materials, machinery, etc., refrigerating plant, shoe shops, and several other departments. The work will be held up until money can be appropriated.

WASHINGTON, IND.—Plans are being considered for changing the system of the Electric Works to single-phase, 60 cycles. W. J. Perrine is superintendent.

LINCOLN, ILL.—A generator to furnish electricity for the Lincoln municipal railway, it is reported, is to be installed in the plant of the Lincoln Water & Light Company.

SYCAMORE, ILL.—The Geneva Lake, Sycamore & Southern Railway Company, which proposes to build an electric railway from the south shore of Geneva Lake, through McHenry, DeKalb, Kendall and La Salle Counties, has been granted a license to incorporate. The company is capitalized at $150,000 and has its main office at Sycamore. For further information address A. E. Hammersmith.

BLOOMER, WIS.—At an election held recently the proposal to purchase the electric plant of the Bloomer Electric Light & Power Company, to be owned and operated by the municipality, was carried.

OMRO, WIS.—The Wisconsin Power, Light & Heat Company of Milwaukee has purchased the property of the Omro Electric Light Company and contemplates extending the Kilbourn and Prairie du Sac transmission lines from Markesan to Berlin and thence to Omro this summer. E. B. Heimbach is division superintendent.

ORFORDVILLE, WIS.—The Orfordville Light & Power Company is considering the erection of an electric transmission line (4½ miles long) to a nearby town. The proposed line will be three phase, 60 cycles, 6600 volts, and will have a carrying capacity of 60 kw. A. E. Tomlin is secretary and manager.

POYNETTE, WIS.—The local electric-light plant, owned by Perry Speed, it is reported, has been purchased by L. M. Libby of Glenwood, Wis.

BOONE, IOWA.—The contract for electric wiring the County Home at Boone has been awarded to the Beck Electric Construction Company of Minneapolis, Minn., at $1,923.

DAVENPORT, IOWA.—The contract for electric wiring the intermediate school at Davenport has been awarded to the Standard Electric Company of Clinton, Iowa. The cost of the building is estimated at $176,000.

ELKADER, IOWA.—Improvements are being made to the system of the Standard Telephone Company, including the installation of underground cables and an aerial cable, to cost about $13,000. About 20,000 ft. of wire will be required.

LORIMER, IOWA.—The Board of Railroad Commissioners has granted the Lorimer Light & Power Company a 25-year franchise to erect and operate an electric transmission line upon certain roads and highways in Union County for the distribution of electricity for lamps and motors.

WATERLOO, IOWA.—The Citizens' Gas & Electric Company of Waterloo has been granted a franchise by the Board of Railroad Commissioners to erect and operate an electric transmission line for the distribution of electricity for lamps and motors over certain roads and highways in Black Hawk County for a period of 25 years.

KANSAS CITY, MO.—The Interurban Central Station Company is contemplating the construction of a new interurban station on McGee Street, between Ninth and Tenth Streets.

KANSAS CITY, MO.—In a report submitted by Burns & McDonnell, consulting engineers, the proposal to install electric generating equipment at the Turkey Creek pumping station was declared feasible and economical. The cost of the proposed electric-lighting plant is estimated at approximately $750 000, and it would serve, it is stated, adequately the territory between Twelfth and Thirty-first Streets and Main Street to the State line.

OZARK, MO.—The Finley Light Company, recently incorporated, has taken over the plant of the Water Power Light Company and is changing the system from 60 cycles to 25 cycles and will connect with the transmission system of the Ozark Power & Water Company, which passes the plant. When connections are made a 24-hour service will be established. George T. Breazeale is secretary and manager.

ST. LOUIS, MO.—The Harry Benjamin Equipment Company, Central National Bank Building, it is reported, is in the market for a 250 to 300-kva., three-phase, 25-cycle, alternating-current transformer.

ST. LOUIS, MO.—Plans have been prepared for the erection of a new telephone exchange building for the Southwestern Telephone Company at Delmar and Lake Avenues, to cost about $85,000. L. R. Timlin is architect.

MADDOCK, N. D.—Plans are being prepared by W. E. Skinner, engineer, Minneapolis, Minn., for the installation of an electric-lighting system, to cost about $7,000.

NOME, N. D.—The installation of an electric-lighting system in Nome is under consideration by the City Council.

SHARON, N. D.—The local electric-light plant has been taken over by the village of Sharon, to be owned and operated by the municipality.

ARMOUR, S. D.—The South Dakota Light & Power Company is completing an addition to its power house, 45 ft. by 60 ft., and is installing a 300-hp. Smith gas producer. The company has purchased a 300-hp. Rathburn-Jones gas engine together with an additional Smith gas producer of 300 hp. The delivery of the new equipment is expected about May 1. A 90-hp. Munzell engine, formerly used at the Platte station, is now being installed. J. F. Cameron is vice-president and manager.

BRANDON, S. D.—The plant of the Brandon Electric Light Company has not been operated since last September. The question of securing power from the plant at Sioux Falls is under consideration. L. D. Kepple is treasurer of the Brandon Electric Light Company.

CENTERVILLE, S. D.—The Centerville Milling Company has completed the construction of a new dam and wheel pits. Later the company will install a new water wheel. A. J. Struble is manager.

MITCHELL, S. D.—Plans, it is reported, have been prepared by Burns & McDonnell, consulting engineers, Kansas City, Mo., for improving the lighting and water systems. R. E. Davis is city auditor.

STEVENS, S. D.—Contract has been awarded by the Alfalfa Products Company to the Younglove Construction Company, United Bank Building, Sioux City, Iowa, for the construction of an alfalfa products plant at Stevens, to cost about $100,000. The proposed plant will be equipped for electric-motor drive. Dale C. Koon, 4201 Garretson Avenue, Sioux City, Iowa, is president. Stevens has not a post office.

ALLEN, NEB.—Bids will be received by the Board of Education, District No. 70, Dixon County, Allen, Neb., until Feb. 27 for construction of high school building. Separate bids to be submitted for electric wiring, heating and plumbing and ventilating. Plans and specifications are on file in the office of the secretary of the Board of Education, Allen, and at the office of R. A. Bradley & Company, architects, Exchange National Bank Building, Hastings, Neb.

DALTON, NEB.—Bids will be received by the city of Dalton until Feb. 26 for one 75-hp. and one 30-hp. special oil engine, complete with compressor tank, and one 50-kva. and one 30-kva. generator.

FALLS CITY, NEB.—Bids will be received by the city clerk, Falls City, until March 4 for equipment for the electric-light plant and water-works system as follows: One 12-in. by 24-in. by 36-in. cross compound Corliss engine; one 16-in. by 32-in. by 36-in. cross compound Corliss engine; one 225-kva., three-phase, 60-cycle, 2300-volt generator; two surface condensers with auxiliaries, one eight-panel switchboard, two 16-kw., 6.6-amp. constant-current transformers and one 750-gal.-per-minute pump with motor. Specifications are on file in the office of the city clerk, Falls City, and may be obtained at the office of the engineers, E. M. Stevens & Company, 708 Ridge Arcade, Kansas City, Mo.

FIRTH, NEB.—Arrangements are being made for improvements to the electric-light plant, including the installation of a 25-hp. gasoline engine, one 16-hp. oil engine and a 15-kw. direct-current generator. Bids, it is understood, have been received for the proposed equipment.

GRANT, NEB.—Bids will be received by the Commissioners of Perkins County, Grant, until March 4 for construction of a high school building. Separate bids to be submitted on plumbing, heating and ventilation and electric wiring. Plans and specifications are on file in the office of H. E. Pankonin, chairman, Grant, and at the office of R. A. Bradley & Company, architects, Hastings, Neb.

BEAVER CROSSING, NEB.—Bonds to the amount of $9,000 for the installation of an electric-lighting system have been sold.

DOWNER, KAN.—The United Telephone Company is contemplating the erection of a telephone exchange building, to cost about $15,000. C. S. Brown of Abilene, Kan., is general manager.

EUREKA, KAN.—Bids will be received by J. W. Kenner, city clerk, Eureka, until Feb. 27 for improvements to water-works system, including construction of water-filtration plant, water-works improvements and two 400-gal.-per-minute vertical centrifugal pumps and motors. Plans and specifications are on file in the office of the city clerk, Eureka, and at the office of Black & Veatch, engineers, Inter-State Building, Kansas City, Mo.

MULVANE, KAN.—The boiler room and refrigerating plant of the Helvetia Milk Condensing Company's plant was recently destroyed by fire, causing a loss of about $20,000.

PITTSBURG, KAN.—Work will begin at once on the construction of the addition to the Normal School at Pittsburg, to cost approximately $200,000. Bids, it is reported, will soon be asked on heating, electric wiring, plumbing, etc. J. M. Leeper of Topeka has the general contract for the work. R. L. Gamble, Topeka, is state architect.

WICHITA, KAN.—Bids will be received at the office of the secretary of the Board of Education, Wichita, until March 11 for the erection of two school buildings, one to be the South Side Intermediate, located on Zimmerly Street, between Market and Lawrence Streets, and the other, the Skinner School, to be located at the corner of Twenty-first and Hydraulic Streets. Separate bids for heating and ventilating system and electric wiring will be received at the same time. Plans and specifications are on file in the office of Lorentz Schmidt, architect, Wichita.

Southern States

RALEIGH, N. C.—The Empire Steel Company is contemplating the construction of a hydroelectric plant to develop about 10,000 hp. to supply energy for its proposed steel plant, which will be equipped with electrically operated machinery. Joel F. Armistead, representative, Raleigh, may give further information.

AMERICUS, GA.—Owing to the great increase in cost of operating its plant the Americus Lighting Company has offered to sell its system to local interests at cost. A committee, consisting of Stephen Pace, Lee Allen and others, has been appointed to consider the advisability of accepting the offer. The company recently asked an increase in rates for electricity and gas, which was opposed by the citizens.

ATLANTA, GA.—The proposal to install an electric generating plant at the city crematory has been approved by the City Council and a committee has been appointed to raise the necessary money. The cost of installing the plant is estimated at about $75,000. Energy generated at the plant will be sold to the Georgia Railway & Power Company.

BRUNSWICK, GA.—The City & Suburban Railway Company is reported to be considering the construction of an extension of its street car line to several industrial plants.

MONTEZUMA, GA.—Plans are being considered by James Harrison and E. M. McKenzie for the installation of a hydroelectric plant on Whitewater Creek, 4 miles from Montezuma. Electricity generated at the plant will be transmitted to Montezuma and Oglethorpe.

POWDER SPRINGS, GA.—The Domestic Electric Company, recently incorporated with a capital stock of $2,500, is contemplating the construction of an electric-light plant. J. D. Middlebrooks is interested in the company.

TY, TY, GA.—At an election to be held on March 8 the proposal to issue $7,000 in bonds for the construction of a municipal electric-light plant will be submitted to the voters.

VALDOSTA, GA.—The construction of a hydroelectric power plant on the Withlocoochee River, it is reported, is under consideration by A. F. Langford, general contractor.

FAYETTEVILLE, TENN.—The stockholders of the Fayetteville Electric Light & Power Company have decided to develop a water power on Elk River at a cost of about $25,000. Machinery, it is understood, will be purchased at once.

HADLEY'S BEND, TENN.—Contract has been awarded by the War Department, Washington, D. C., to the Thompson-Starrett Company, 51 Wall Street, New York, N. Y., for the construction of explosive manufacturing plant, to cost $60,000,000. The site contains nearly 5000 acres, of which buildings will cover 2000 acres. The warehouses and power houses will be of brick construction, other buildings will be of corrugated iron on wooden frames. The government will build several thousand dwellings for employees.

NASHVILLE, TENN.—Preliminary surveys will be made by the Nashville-Gallatin Interurban Railway Company for the proposed extension from Madison to Neeley's Bend Ferry to serve to government powder plant.

DOTHAN, ALA.—The Columbia Power Company is building a hydroelectric power development at Kelso, consisting of two reinforced concrete power dams, timber storage dam, 26 miles of 44,000-volt transmission lines. All equipment has been purchased. It is estimated that 1500 hp. will be developed at a cost of about $250,000. Electricity generated at the plant will be transmitted to Dothan, Columbia and Headland. Tucker & Laxton of Charlotte, N. C., are engineers. Dermott Shemwell of Lexington, N. C., is president.

FLORENCE, ALA.—Frank L. Davies of Danville, Ill., it is reported, is interested in a project to construct an electric railway from Huntsville to Florence, a distance of about 64 miles.

LITTLE ROCK, ARK.—Contract has been awarded by the Little Rock Railway & Electric Company for the installation of a turbine to cost about $200,000.

BRISTOW, OKLA.—The City Council has voted to issue $36,000 in bonds to take over the local electric-light plant, to be owned and operated by the municipality.

KINGSTON, OKLA.—The Kingston Ice & Light Company is planning to rebuild its plant, recently destroyed by an explosion, causing a loss of about $25,000.

OKEMAH, OKLA.—The City Council is considering calling an election to vote on the proposal to issue bonds for improvements to the municipal electric-light plant, water-works and sewer system.

STILLWATER, OKLA.—An election will soon be called to vote on the proposal to issue $175,000 in bonds for improvements to water works, municipal electric-light plant and sewer system.

BOWIE, TEX.—The Texas Light & Power Company is planning to rebuild its electric-light and power plant, recently destroyed by fire, causing a loss of about $8,000.

CANYON, TEX.—The Canyon Power Company, it is reported, will rebuild its electric plant recently destroyed by fire.

HARLINGEN, TEX.—The municipal electric-light and water plant has been leased to A. Goldammer for a period of five years. Mr. Goldammer, it is understood, will extend the service and build an ice factory.

HOUSTON, TEX.—The City Council is reported to be considering the construction of a municipal belt line in Houston, for which plans have been prepared. E. E. Sands is city engineer.

LA PORTE, TEX.—The La Porte Water, Light & Ice Company is considering the installation of a new generator, ice machine, engine, and making line extensions. Nothing definite as yet has been decided upon. Philip J. Pfeiffer is owner and manager.

Pacific and Mountain States

CHELAN FALLS, WASH.—Contracts have been closed by the Wenatchee (Wash.) Valley Gas & Electric Company for the construction of a 1000-hp. power plant at Chelan Falls. Orders have been placed for machinery and materials and it is hoped to have the plant in operation by July 1, 1918.

COLVILLE, WASH.—A contract has been closed between the Washington Water Power Company of Spokane and the Stevens County Light & Power Company of Colville, whereby an electric transmission line, 40 miles long, will be erected to furnish electricity in the southern part of Stevens County.

EPHRATA, WASH.—The Intermountain Power Company has petitioned the Commissioners of Grant County for a franchise to construct and operate an electric transmission line over certain highways in Grant County.

EVERETT, WASH.—The Norway-Pacific Construction & Drydock Company of Everett, recently organized, has purchased a site in Everett on which it will build a shipbuilding plant to cost about $1,000,000. Plans have been prepared for a large number of buildings, including ways for five steel ships, two wooden ships, wharves and a 10,000-ton capacity floating sectional dry dock; a pattern shop and foundry, a machine and engine shop, and annealing, forge and boiler works, a power house, and steel fabricating shop. 30 ft. by 240 ft. M. G. Thomle is president.

LA GRANDE, WASH.—Preparations are being made by the American Nitrogen Products Company for the installation of three electric ovens at its plant.

SEATTLE, WASH.—Contract has been awarded by the Board of Public Works to the Pacific Lamp & Supply Company of Seattle for furnishing 500,000 incandescent electric lamps for the municipal lighting department, to cost about $100,000.

SEATTLE, WASH.—Bids will soon be called for by the Board of Public Works for the construction of the new Ballard substation, to be erected at Fourteenth Avenue N. E. and West Forty-ninth Street, for the municipal lighting department. Plans now being made ready by Daniel Huntington, city architect, call for a two-story and basement reinforced structure, 55 ft. by 55 ft., providing space for two motor-generator sets. Provision will be made for further extensions.

SEATTLE, WASH.—Final action has been taken by the City Council on the passage of an ordinance providing for advertising for bids for a municipal electric-light plant. The ordinance is designed to supplement the previous action in advertising for bids for the construction of a hydro-electric plant on the public domain, so as to enable any one who has a power site to offer it to the city fully developed if he cares to do so. Bids under this ordinance as well as the former will be received until March 1. No bid will be considered if the amount of energy to be developed is less than 10,000 kw. The bids submitted must include a plant fully completed, including necessary dams, wires, diversion works, storage basin, pipe lines, tunnels, conduits, etc. The cost of the proposed system is estimated at about $5,000,000. C. B. Bagley is secretary of board of public works.

SPOKANE, WASH.—Plans have been completed by City Engineer Butler for the installation of a new ornamental lighting system on Post Street from the new Post Street Bridge to Third Avenue. The cost is estimated at $37,740.

STEILACOOM, WASH.—The installation of a municipal water-works system is under consideration in connection with lighting plant. A 12½-hp. electrically-operated pump has been purchased for same. R. F. Gleason is electrician.

TACOMA, WASH.—An ordinance is being prepared under the direction of H. F. Gronen, commissioner of the light and water department, which will be submitted to the voters at the election to be held on April 2, asking their opinion on the purchase of a $5,000,000 power plant for the city of Tacoma.

MARSHFIELD, ORE.—Arrangements are being made by the C. A. Smith Lumber Company to install additional electric equipment to double the output of its mill. Machinery, costing about $80,000, for the second unit, it is reported, has been ordered.

AZUSA, CAL.—Preparations are being made to increase the output of the substation of the municipal electric-lighting system to 600 kva., at a cost of about $4,000. Norman E. Humphrey is superintendent.

CHICO, CAL.—The contract for furnishing electricity for maintaining the electrolier lighting system has been awarded to the Northern California Power Company.

PITTSBURG, CAL.—The Pacific Gas & Electric Company has submitted a proposal to the City Trustees for installing an electric service for the southwest addition. The cost is estimated at about $2,000.

SAN DIEGO, CAL.—The Railroad Commission has granted the San Diego Consolidated Gas & Electric Company permission to distribute and sell electricity under a franchise granted by San Diego County, provided it does not operate in the territory now served by the Del Mar Light & Power Company or the Escondido Mutual Water Company.

MONTICELLO, UTAH.—The capital stock of the Blue Mountain Irrigation Company has been increased from $15,000 to $60,000. Amendments have been filed to the charter of the company giving permission to generate and distribute electricity. F. I. Jones is president.

OGDEN, UTAH.—Bids will be received at the office of the chief clerk, Department of Agriculture, Washington, D. C., until March 6 for furnishing office supplies, instruments, field equipment, furniture and telephone and fencing materials to the Forest Service Supply Department Depot at Ogden, Utah, during the fiscal year beginning July 1, 1918. Proposal blanks and further information may be obtained on application to the above office or to the purchasing agent, Forest Service, Ogden, Utah.

PROVO, UTAH.—Application has been filed with George F. McGonagle, State Engineer, by Scott P. Stewart of Provo for permission to take from the north and south branches of North Fork Creek 10 second-feet of water. The plans provide for the construction of a cement dam and a 21-in. iron or wood stave pipe to carry the water to a point where power will be generated by a Pelton water wheel, operated under a 1400-ft. head of water. Electricity generated at the proposed plant will be distributed in Utah and Wasatch Counties.

SWEETGRASS, MONT. — The Toole County Telephone Company, recently organized, is planning to erect about 200 miles of telephone line.

WORLAND, WYO.—The Worland Light & Power Company expects to install a 125-hp. boiler and also to purchase various instruments for switchboard. J. M. Atkinson is manager.

DENVER, COL.—The Queen City Foundry Company of Denver has placed an order for a one-ton Booth-Hall electric steel furnace to replace the converter equipment now in use. The furnace has a holding capacity of three-quarters to one ton, and is rated at 300 kva. Energy will be delivered to the furnace by the Denver Gas & Electric Company.

Canada

BRANDON, MAN.—The installation of an electric generating plant to furnish electricity for municipal purposes, including the street railway system, is under consideration by the City Council.

WOODSTOCK, N. B.—A committee has been appointed by the Woodstock Board of Trade to confer with the federal and provincial governments on the advisability of utilizing the water powers of Grand Falls, Tobique and Meductic in New Brunswick for power and fuel purposes.

CHATHAM, ONT.—The Chatham, Wallaceburg & Lake Erie Railway Company, it is reported, is contemplating utilizing hydroelectric power on the Chatham-Wallaceburg section of its system. Owing to coal shortage the company has not been able to generate sufficient power to keep the line in operation.

TORONTO ONT.—The plant of the Toronto Laundry Machinery Company, Sorauren Avenue and Dundas Street, was recently destroyed by fire causing a loss of about $200,000. It had been utilized for the manufacture of shells and will be rebuilt at once.

TORONTO, ONT.—A portion of the plant of the Metropolitan division of the Toronto & York Railway Company, including repair shop, was recently destroyed by fire, causing a loss of about $100,000. Considerable machinery, it is understood, will have to be replaced.

Miscellaneous

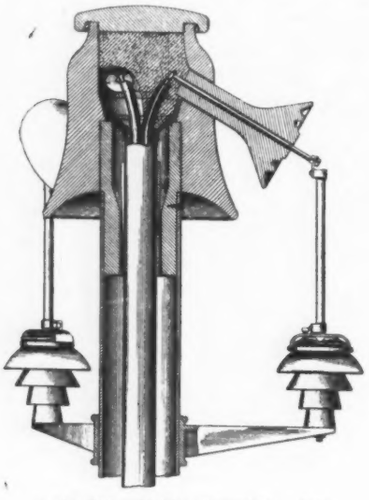
PETERSBURG, ALASKA.—The Council is considering the installation of a turbine at or near the water-works dam with a view of developing power for operating the electric-lighting plant.

(Issued Jan. 22, 1918.)

1,254,432. Telegraph-Receiving Instrument; Charles Adams-Randall, Boston, Mass. App. filed Nov. 28, 1918. Provides a means for augmenting the received signals and rendering them more clear than has been heretofore possible.

1,254,471. Signaling Circuit; George A. Campbell, Montclair, N. J. App. filed Sept. 9, 1916. Improvements.

1,254,472. Signaling Circuit; George A. Campbell, Montclair, N. J. App. filed Sept. 9, 1916. Provides a substation consisting of transmitter, receiver, auxiliary resistance and a transformer having a



1,254,938—Cable Terminal Pole

plurality of windings in combination with a telephone line.

1,254,473. Signaling Circuit; George A. Campbell, Montclair, N. J. App filed Sept. 9, 1916. Object is to provide signaling means characterized by the maximum possible ratio of received and transmitted energy and further characterized by the absence of side tone.

1,254,476. Signaling Circuit; George A. Campbell, Montclair, N. J. App. filed May 18, 1917. Improvements.

1,254,477. Circuit-Breaking Device; Walter W. Carpenter, Lansdowne, Pa. App. filed Oct. 10, 1916. For use in connection with voltage regulators for electric generators.

1,254,490. Multiple-Fuse Cartridge; Frederick A. Feldkamp, Newark, N. J. App. filed Nov. 6, 1916. Improved construction.

1,254,528. Molding Adapter; Henry T. Paiste, Philadelphia, Pa. App. filed Dec. 11, 1913. May be detachably connected to a metallic or other molding containing electric conductors.

1,254,531. Method or Process of Smelting Zinc; Isak Partanen, Telluride, Col. App. filed Feb. 2, 1916. Improvements.

1,254,584. Ignition Device; Arthur Dickerson, Salt Lake City, Utah. App. filed Sept. 17, 1917. For internal-combustion engines.

1,254,620. Method of and Means for Measuring Voltages; Max G. Newman, Lanesboro, Mass. App. filed March 1, 1917. For measuring the maximum voltage in a circuit supplied by a variable source of potential, such, for example, as an alternating-current generator.

1,254,633. Junction-Box Coupling for Electric Conduits; John N. Scism, Brooklyn, N. Y. App. filed Dec. 21, 1911. Improvements.

1,254,641. Floor Box; Frederick B. Adam, St. Louis, Mo. App. filed April 10, 1916. Comprises a reversible member which forms a flat cover plate for the box when arranged in one position, and when reversed or turned upside down forms a cover provided with a nozzle or raised support for an insulator bushing adapted to receive a cord or electrical conductor leading out of the box.

(Issued Jan. 29, 1918.)

1,254,642. Automatic Circuit-Changing Switch; Arthur H. Adams, Sparkill, N. Y. App. filed Aug. 4, 1916. Improvements.

1,254,657. Telephone-Exchange System; Henry P. Clausen, Mount Vernon, N. Y. App. filed March 13, 1915. Relates to telephone exchange systems of the central energy type and has for its object the production of improved signaling means for such systems.

Record of Electrical Patents

Notes on United States Patents

1,254,658. Impulse-Transmitting Device or Sender; Henry P. Clausen, Mount Vernon, N. Y. App. filed Oct. 26, 1916. Relates to senders for controlling selectively operable switching devices employed in automatic and semi-automatic telephone systems.

1,254,661. Counting Apparatus; Amos F. Dixon, Newark, N. J. App. filed May 24, 1915. Improvements.

1,254,663. Method of Treating Metal Parts to Prevent Solder Adhering Thereto; Louis W. Downes, Providence, R. I. App. filed July 10, 1917. Improvements.

1,254,679. Automatic Telephone-Exchange System; Charles L. Goodrum, New York, N. Y. App. filed July 23, 1915. Improvements.

1,254,680. Automatic Telephone System; Charles L. Goodrum, New York, N. Y. App. filed Jan. 3, 1916. Means for eliminating as far as possible the impluse or stepping relays.

1,254,681. Non-Numerical Switch; Charles L. Goodrum, Brooklyn, N. Y. App. filed Sept. 11, 1916. Type employed in completing connections between calling and trunk lines.

1,254,682. Telephone-Exchange System; Charles L. Goodrum, New York, N. Y. App. filed Feb. 10, 1917. Relates to machine-switching telephone-exchange systems with subscribers' control and has for its object the provision for partial supervision in systems of this character.

1,254,691. Telephone System; Edward E. Hinrichsen, New York, N. Y. App. filed April 24, 1917. To reduce the amount of apparatus required in central energy systems.

1,254,697. Adjustable Support for Electric Lamps; Johan P. Johansson, Fauna, Enkoping, Sweden. App. filed Jan. 2, 1917. Comprising a flexible electric conductor from which the lamp is suspended and a jointed support for said conductor, the arrangement being such that the support may be swung through any desired angle and the conductor drawn to the desired extent through its support without liability to damage or unduly wear the conductor.

1,254,700. Anti-cathode; Edwin W. Kelly, Philadelphia, Pa. App. filed Sept. 30, 1916. For electric vaccum tubes, and particularly anti-cathodes employed in X-ray tubes.

1,254,702. Excavating Machine; Charles B. King and Frank Rensenberger, Marion, Ohio. App. filed June 16, 1917. Applies particularly to a machine for excavating and loading coal.

1,254,703. Strain Relief for Pendent Electrical Devices; Charles J. Klein, Milwaukee, Wis. App. filed June 6, 1914. The grip on the conductor is effected between the socket base and a loose member retained by a part of the casing.

1,254,707. Meter Cut-Out and Testing Device; Earle A. Le Fever, Buffalo, N. Y. App. filed July 25, 1913. Improvements.

1,254,710. Selector-Switch Movement-Controlling Circuit; Alben E. Lundell, New York, N. Y. App. filed Jan. 29, 1916. For use in automatic telephony.

1,254,711. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed June 13, 1916. Applies particularly to line testing and guarding arrangements for automatic or semi-automatic telephone exchanges.

1,254,712. Telephone-Exchange System; Alben E. Lundell, New York, N. Y. App. filed June 17, 1916. In which the establishment of connections is controlled from an operator's position.

1,254,713. Automatic Switch; Frank A. Lundquist, New York, N. Y. App. filed Nov. 20, 1916. For interconnecting telephone lines.

1,254,736. Magnetic Chuck; Frank L. Simmons, Millbury, Mass. App. filed Nov. 5, 1914. Improvements.

1,254,758. Mechanical Rectifier; Arthur W. Winterborne, San Antonio, Tex. App. filed June 24, 1916. Adapted especially for use upon Ford automobiles.

1,254,769. Alarm; Clarence A. Braconier, Wayne, Mich. App. filed June 9, 1917. Combined thermal and electric alarm that may be advantageously used as an automatic fire alarm and a heat alarm for brooders and indicators at places where it is desirable that a predetermined temperature shall cause the operation of audible signal.

1,254,787. Advertising Device; Alphonse Fernandez, Washington, D. C. App. filed Jan. 10, 1917. Provides means whereby a great number of advertising signs or cards may be displayed in a relatively small space.

1,254,812. Electric-Switch Casing; Charles L. Klein, Milwaukee, Wis. App. filed Dec. 8, 1913. Improved means for securing covers to surface switch bases.

1,254,814. Thermostat; Edwin B. Lane, West Hoboken, N. J. App. filed Nov. 4, 1916. Proof against vibration.

1,254,830. Means for Compensating for Disturbances of Earth Potential; Joseph W. Milnor, New York, N. Y. App. filed March 10, 1917. At the two ends of a system of communication and to avoid any periodic oscillation of potential due to the action of the compensating means itself.

1,254,831. Method of and Means for Correcting for Alternating-Current Electromagnet Induction and for Alternating-Current Earth Potential; Joseph W. Milnor, New York, N. Y. App. filed March 10, 1917. Comprises means, including alternating-current generators and automatic regulating devices therefor, for applying to the communication circuit or circuits a correcting potential of proper voltage phase and frequency.

1,254,849. Burglar Alarm; Willis C. Reed, Cambridge, Ill. App. filed Aug. 10, 1915. Improvements.

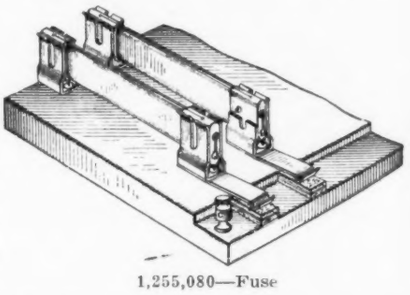
1,254,851. Engine Starter; Julius H. Richards, Newark, N. J. App. filed Dec. 14, 1914. The feature is the mounting of the gear which engages the engine on a shaft which passes through the armature of the electric motor yet is separate therefrom, thus allowing the armature to remain in a permanent position within its field, by which means it is always in a position to exert its greatest torque.

1,254,864. Electric Alarm; Everett S. Taber, Canton, Mass. App. filed March 30, 1915. Comprising a bell or gong, a hammer and electromechanical means for causing the hammer to strike the bell.

1,254,880. Electric Vibrator; William C. Brinton, Jr., Kennett Square, Pa. App. filed Oct. 24, 1916. Improvement.

1,254,886. Cut-out for Electric Circuits; Nicholas J. Conrad, Chicago, Ill. App. filed June 4, 1917. Inserts a resistance in series with the circuit to be disconnected before actually breaking the circuit.

1,254,902. Adjustable-Speed Motor; Willis W. Hale, Cleveland, Ohio. App. filed Nov. 20, 1915. Operates without serious or detrimental sparking, by rotating brushes engaging a commutator which is connected to the primary or inducing winding.



1,255,080—Fuse

1,254,910. Means for Compensating for Disturbances of Earth Potential; Paul J. Howe, Ridgewood, N. J. App. filed March 10, 1917. For compensating for differences of potential between the ground connections at the two ends of a system of electrical communication.

1,254,938. Cable-Terminal Pole; Edmund O. Schweitzer, Chicago, Ill. App. filed Sept. 21, 1914. Improvements.

1,255,080. Fuse; Wallace L. Cook, Chicago, Ill. App. filed Feb. 9, 1917. Fuse wire is carried in a strip of insulating material, preferably wood.